OCTOBER, 1934.

GENERAL PHYSICS.

ADSORPTION.

3958. Tenacity of Active Carbons for Vapour. Part V. F. Krczil and H. Wejroch. *Kolloid Zeits.* 68. *pp.* 29–32, *July*, 1934.—The amounts of benzene taken up from a benzene-air mixture by charcoal have been measured for different concentrations and temperatures of 20° C. and 100° C. Gas-activated and a $ZnCl_2$-activated charcoal have been used. The charcoal which sorbs most at 20° also sorbs most at 100° C, but the superiority is not so marked at the higher temperature. [For Part IV see Abstract 3069 (1934).] F. J. W.

3959. Adsorption of Hydrogen by Palladium Black. V. Ipatieff and W. G. Tronow. *J. Phys. Chem.* 38. *pp.* 623–633, *May*, 1934.—The solubility of hydrogen in palladium black was determined at 15°, 25°, 100°, 150°, 200°, and 300° C. at pressures of from 1 to 27 atmospheres. In agreement with data of Hoitsema, isotherms obtained are characterised by the presence of peculiar parallel parts, distinguishing hydrogen adsorption in palladium from other adsorption isotherms. It is shown that with increase of temperature these parallel parts displace themselves in the direction of high pressures and begin to incline from the vertical; at 300° C. this tends to disappear and the whole curve becomes straightened out. AUTHORS.

3960. Adsorption of Hydrogen and Nitrogen by Solid Cobalt. A. Sieverts and H. Hagen. *Zeits. f. phys. Chem.* 169. *Abt.A.* 3–4. *pp.* 237–240, 1934. The solubilities of H_2 and N_2 have been determined at 1 atmosphere pressure for the temperature range 600°–1200° C. For H_2 the amount sorbed is proportional to the square-root of the pressure. Further, the addition of 2 % of Fe to Co scarcely affects the H_2 solubility. N_2 is practically insoluble in Co up to temperatures of 1200° C.

F. J. W.

3961. Adsorption of Gases in Metals. W. Koch. *Zeits. f. techn. Physik,* 15. 7. *pp.* 280–284, 1934.—The solubility of H_2 and N_2 in Al and Cu and their alloys have been measured together with the solubility of H_2 N_2, CO, CO_2 in Cu and Cu alloys at various temperatures. The isobars for Cu-Al alloys reveal the transition ranges of the alloy system.

F. J. W.

3962. Adsorption of Oxygen and Hydrogen on Compact Platinum. H. Reischauer. *Zeits. f. phys. Chem.* 26. *Abt.B.* 6. *pp.* 399–412, 1934.—It is found that hydrogen is not appreciably adsorbed by platinum foil between 20 and 700° C. and at pressures below 5×10^{-2} mm. Hg. Oxygen is not appreciably adsorbed at room-temperature, but at higher temperatures "activated adsorption" occurs. This is of two kinds, associated with different heats of activation and taking place in different temperature ranges. The proportion of the platinum surface available for the respective kinds of adsorption depends upon the previous treatment, but the total adsorbed oxygen remains constant and equivalent to about five layers. The adsorption velocity is found to be practically independent of pressure, except for an initial stage of higher velocity in the case of the adsorption type with the lower heat of activation. The oxygen adsorbed during this initial stage reacts especially readily with hydrogen. The mechanism of adsorption is discussed. L. A. W.

3963. Adsorption of Gases by Copper Powders Prepared by High-Vacuum Disintegration. F. Durau and H. Franssen. *Zeits. f. Physik*, 89. 11–12. *pp*. 757–773, *July* 13, 1934.—Copper fused *in vacuo* has been disintegrated also *in vacuo*, and the powder used to measure the adsorption of N_2, H_2, C_2H_6, C_2H_4 and CO on copper at 20° C. and pressures up to 1 mm. A definite, but not measurable adsorption was obtained. O_2 and CO_2 are chemi-sorbed on copper. F. J. W.

3964. Adsorption of Hydrogen and Deuterium on Catalysts. J. Pace and H. S. Taylor. *J. Chem. Phys*. 2. *pp*. 578–580, *Sept*., 1934. —The velocities of adsorption of hydrogen and deuterium have been measured on the hydrogenating oxide catalysts, chromium oxide and zinc-oxide-chromium oxide and on a supported nickel catalyst. The velocities of adsorption of the two gases are identical, within the experimental error, over a range of temperature on each surface. The fundamental importance of these observations in the theory of activated adsorption and in chemical kinetics generally is emphasised. AUTHORS.

3965. Adsorption of Ethylene by Silica and Nickel. E. W. R. Steacie and H. V. Stovel. *J. Chem. Phys*. 2. *pp*. 581–584, *Sept*., 1934. —The adsorption of ethylene by silica has been investigated from 20 to 300° C. Over this range equilibrium is reached practically instantaneously in all cases. The adsorption of ethylene by reduced nickel has been investigated from – 80° to 150° C. Definite slow effects and temperature hysteresis were observed. Since diffusion into the crystal lattice (" solubility ") is extremely unlikely in this case, more definite conclusions can be drawn than have been possible in previous investigations. AUTHORS.

3966. Adsorption of Alkali Metals on Metal Surfaces. Part I. Formation and Adsorption of Ions. Potential Curves. J. H. de Boer and C. F. Veenemans. *Physica*, 1. *pp*. 753–762, *July*, 1934. *In English*.—The atoms of alkali metals are adsorbed as ions at pure metal surfaces if $Q_i + \epsilon\phi_0 > Q_a + I$, where Q_i is the adsorption energy of the ions, $\epsilon\phi_0$ the work done in extracting an electron from the surface, Q_a the adsorption energy for the atoms and I their ionisation potential. If in addition $\epsilon\phi_0 > I$, evaporation of the adsorbed positive ions in the form of positive ions occurs at higher temperatures. These adsorption phenomena can be explained on the basis of chemical attraction (van der Waals attractive forces) as can be shown with the assistance of potential curves giving the energy of the ion at different distances from the surface. The surface acts as negative partner. The energies of various alkali ions are evaluated from these considerations. F. C. C.

3967. Heat of Wetting of Charcoals of Graded Activity, in Relation to Adsorptive Capacity and Retentivity. S. H. Bell and J. C. Philip. *Chem. Soc., J. pp*. 1164–1169, *Aug*., 1934.—Charcoals of graded activity—both wood and sugar charcoals—have been prepared by air treatment at 700–900°. The heats of wetting with benzene (mainly) and the adsorption and retentivity (for benzene vapour) have been determined. The heat of wetting is found, in general, to be more definitely related to the retentivity than to the adsorption. The air-treatment in its initial stages has been found to reduce the adsorptive power of sugar charcoal. No appreciable adsorption of dissolved substances of large molecular dimensions (such as naphthalenesulphonic acid and methylene-blue) occurs with sugar charcoal until a certain stage in the air-oxidation has been reached. AUTHORS.

3968. Adsorption. A. Kemper. *Zeits. f. phys. Chem.* 169. *Abt.A.* 3-4. *pp.* 275-286, 1934.—The adsorption of methyl violet and methylene blue from aqueous solutions has been measured on Ag and Ni wires in the original outgassed state and after heating at 400° C. for various times. Heating caused a marked decrease in the amount adsorbed, and the saturation value was much smaller than the amount corresponding to a unimolecular layer. Etching of the metals with HNO_3 caused an increase in adsorption. All these phenomena are explainable if it is assumed that the edges and corners of crystals are particularly powerful adsorption centres. F. J. W.

See also Abstracts 4018, 4034, 4362.

ATOMIC AND MOLECULAR STRUCTURE.

3969. Binding Energy and Mass of the Neutron, and Grouping of Atomic Nuclei. G. Monod-Herzen. *Comptes Rendus,* 199. *pp.* 45-46, *July* 2, 1934.—Assuming that the heavier isotopes of an element consist of the lightest with addition of the necessary number of neutrons, the average addition of mass per neutron deduced from some 20 elements is 0·9995. The mass of a free neutron being 1·0085 there is loss of mass on binding of 0·009 per added neutron, equivalent to energy of 10^7 e.v. A similar figure is deduced for addition of a proton to a nucleus. The losses per added neutron for the different elements classify them into seven groups in each of which that loss is approximately identical; the groups show no other apparent interrelationships. C. A. S.

3970. Application of Pauli's Principle to Nuclei. Part II. W. M. Elsasser. *J. de Physique et le Radium,* 5. *pp.* 389-397, *Aug.,* 1934.—Further reasons, based on the relative amounts, numbers, and stability of isotopes, are given in support of the view that atomic nuclei consist of neutrons and protons, both arranged in levels: (for the first 82 elements) 1*s*, 2*p*, 3*d*, 4*f*, 5*g*, 4*d*, and 6*h*, ending respectively with elements containing 2, 6, 10, 14, 18, 10 and 22 neutrons, and 2, 6, 10, 10, 10, 8, and 10 protons. A prediction is deduced that Pd will be found to consist of the isotopes 104, 105, 106 and 108, the proportion of 106 being by far the greatest, that of 105 very small. Grounds are then adduced for considering that in each level the layer of neutrons is more closely associated with that of protons in the same level than with the rest, *e.g.*, in level 4*f* 14 neutrons and 10 protons, to form a sub-group (the α-particle is a special type of sub-group); the building of the two layers proceeds *pari passu* in passing from element to element; levels partially occupied behave as regards Pauli's principle as though fully occupied. The neutrons exert more influence than the protons, especially as regards distribution of isotopes, on account of their greater number. [For Part I see Abstract 7 (1934).] C. A. S.

3971. Nuclear Transformations and the Classification of Light Elements. G. Petiau. *J. de Physique et le Radium,* 5. *pp.* 426-430, *Aug.,* 1934.—Previous work is extended [see Abstract 2422 (1934)]. A system of nuclear reactions brought about by α-particles, protons, and deutons is deduced for elements of atomic number less than 15, based on the fact that these elements can be arranged in series homologous with those of the radioactive elements with regard to variation of electric charge, assuming that these series represent the natural method of building up of elements into stable products, and that all products not falling within the scope of the series are unstable. On this theory the number of groups of elementary particles emitted in the various cases can be obtained without reference to the theory of energy levels of the protons and nuclear electrons. N. M. B.

3972. Appearance of Atoms as Determined by X-Ray Scattering. E. O. Wollan and A. H. Compton. *J.O.S.A.* 24. *pp.* 229–233, *Sept.*, 1934.—Photographs are shown which are the images of atoms of He, Ne and A as obtained by X-ray diffraction, magnified about 2×10^8 times. The images are obtained by photographing a rotating template whose shape is calculated by a mathematical transformation of the measured values of the X-rays scattered by the respective gases. This mathematical-mechanical procedure corresponds to the lens which forms the image when a microscope is used. The images formed by this procedure should be true representations of the electron distribution in the atom, except for the limited resolving power and certain minor abberrations. The photographs show the He atom as a diffusely continuous region filled with electricity. In Ne, the inner group of K electrons is clearly distinguishable from the L electron group. The resolving power is insufficient to distinguish the K and L groups of electrons in A, but does separate these from the M electrons. The appearance of these atoms is in good accord with modern quantum theory of atomic structure. AUTHORS.

3973. Excitation Function of Proton Emission from the Aluminium Nucleus Bombarded by High Energy α-Particles. O. Haxel. *Zeits. f. Physik*, 90. 5–6. *pp.* 373–383, *Aug.* 21, 1934.—Using a Geiger counter at a potential of 4500 V and containing argon at 2·5 atmospheres, the variation of the proton yield from Al under bombardment by α-particles when the effective range was varied from 0 to 8·6 cm., was investigated at an angle of about 90° to the incident particles. Taken as a whole, the effective cross-section of the Al nulceus increases with increasing energy of the α-particles. Detailed examination of the relative yields due to the four disintegration processes [see Abstract 2257 (1934)] shows that there is no increase in yield for groups 1 and 2 when the range exceeds 6 cm. but the yield from the remaining groups continues to increase rapidly. The results can be explained on the assumption that the probability of entrance of the α-particle into the nucleus along the resonance levels, with subsequent disruption, depends on the relative change in angular momentum which results. F. C. C.

3974. Artificial Radioactivity Induced by Neutron Bombardment. M. S. Livingston, M. C. Henderson and E. O. Lawrence. *Nat. Acad. Sci., Proc.* 20. *pp.* 470–475, *Aug.*, 1934.—Continuing Fermi's work [see Abstract 3232 (1934)] on the radioactivity artificially induced by neutron bombardment, the great activity produced in CaF_2, Al and Ag was confirmed. Smaller effects were obtained with Si, Cu and Zn, but no appreciable activity was detected in Li, Be, B, C, Mg, Na, Cl, Ca, Zr, Cr, W, Pt, Bi or Pb. The substances were exposed for about 5 min. to a beam of neutrons (from a Be target bombarded by 1 μA of 2·6 MV deutons) and subsequently placed near a Geiger counter. Counts of the order of several hundred per min. were observed. The half-value periods were found to be: F 10 sec., Ag 2 min. 34 sec. and 26 sec., Al 9 min. 30 sec., Cu 7 min. By magnetic deflection, the particles emitted from Al and Ag were shown to be electrons. The maximum energies of the two groups of electrons emitted from Ag are about 1·6 MV and 3 MV respectively and the results agree well with Sargent's curves [see Abstract 2326 (1933)] for natural β-ray emission. It is estimated that there is a high probability of activation whenever a neutron makes a nuclear collision. F. C. C.

3975. Artificial Radioactivity Produced by Neutron Bombardment. E. Fermi, E. Amaldi, O. D'Agostino, F. Rasetti and E. Segrè. *N. Cimento,* 11. *pp.* 429–460, *July,* 1934. *Roy. Soc., Proc.* 146. *pp.* 483–500, *Sept.,* 1934.—The element, or a suitable compound, was bombarded with neutrons from a mixture of Be and Rn emitting about 8×10^5 neutrons/sec., the accompanying γ-radiation not affecting the result. Any electrons emitted (no positrons were detected) were examined in a Geiger-Müller counter, and decay curves determined. After activation the probable chemical nature of the product was determined when possible. The cross-sections for neutron impact for elements most intensely activated imply that a large percentage of the neutrons which hit the nucleus produce an active atom. With light elements this seems to be due to capture of the neutron followed by expulsion of a proton or α-particle. But with heavier elements the stronger potential barrier round the nucleus renders such expulsion less probable, and an isotope of the bombarded element seems usually to result, for the mechanism of which alternative explanations are discussed. [See Abstracts 1546, 3231, 3232 (1934).] A table giving the half period, mean energy of β-rays and probable active element formed, is given for F, Mg, Al, Si, P, S, Cl, V, Cr, Mn, Fe, Co, Cu, Zn, As, Br, I, Ir, Au and U. In the case of Na, Ga, Se, Rb, Mo, Rh, Pd, Ag, Cd, Te, Cs, Ba, Pr, Nd, Sm, Pt and Th the nature of the element formed was not determined (the half periods being given). Slight indications of activity, perhaps due to impurity, were shown by Be, B, Ti, Zr, Sn, Sb, W, Hg and Tl, and none by H, Li, C, N, O, Ca, Ni, Sr, Y, Ru, Sn, La, Ce, Ta, Re, Os, Pb and Bi. C. A. S.

3976. Artificial Disintegration by Radium C′ α-Particles—Aluminium and Magnesium. W. E. Duncanson and H. Miller. *Roy. Soc., Proc.* 146. *pp.* 396–419, *Sept.* 1, 1934.—An electrical counting method has been developed for the counting of α-particles and protons in the presence of strong β- and γ-radiations. The method has been applied to the examination of the protons emitted when aluminium and magnesium are bombarded by the α-particles from Ra C′. From the experiments on aluminium evidence has been obtained for the existence of three excited α-particle levels in the nucleus resulting from the transmutation; and two resonance levels have been found in the aluminium potential barrier at energies greater than the four found by Chadwick and Constable. An estimate has also been obtained for the minimum energy for which α-particles can penetrate the top of the potential barrier. The experiments on magnesium indicate two excited α-particle levels in the resulting nucleus and two resonance levels in the potential barrier above an energy of $5{\cdot}25 \times 10^6$ e-volts. AUTHORS.

3977. Artificial Nuclear γ-Rays, Neutrons and Positrons. R. Fleischmann and W. Bothe. *Ergeb. d. exakt. Naturwiss.* 13. *pp.* 1–56, 1934.—The paper consists of a summary of the fundamental experimental facts relating to artificial γ-rays, neutrons and positrons produced by α-rays, and, more briefly, by protons and deutons. Over 200 references are given. W. E. P.

3978. Transformation of Elements by Fast Hydrogen Nuclei. F. Kirchner. *Ergeb. d. exakt. Naturwiss.* 13. *pp.* 57–88, 1934.—A review of the methods of obtaining fast hydrogen nuclei and the results obtained by their use for the bombardment of Li, B, C and other elements. The various transformation processes are discussed and summarised. Numerous references are given. W. E. P.

3979. Disintegration of Li^6 by Protons. I. Kurtschatow and C. Sinelnikov. *Phys. Zeits. d. Sowjetunion*, 5. 6. *pp.* 919–921, 1934. *In English.*—The authors state that the assumption that the particles of ranges 0·65 cm. and 1·15 cm. emitted when Li is bombarded by protons are respectively nuclei of He^4 and He^3 is not contrary to experimental observation and on this basis the value 3·0166 is obtained for the mass of the isotope He^3. By assuming that the reaction $He^3 + e = H^3 + h\nu$ indicates the origin of the γ-rays observed when Li is bombarded by protons, a value 3·0151 for the mass of He^3 is obtained. W. E. P.

3980. Radioactivity of He^3. I. Kurtschatow, C. Sinelnikov, G. Shchepkin and A. Wiebe. *Phys. Zeits. d. Sowjetunion*, 5. 6. *pp.* 922–926, 1934. *In English.*—The paper describes the experiments made to determine whether the reaction $He^3 = He^3 + \overset{+}{e} + W$ occurs, when Li is bombarded by fast protons. The results show that a positron disintegration of He^3 is highly improbable. W. E. P.

3981. Hydrogen Isotope. R. Frerichs. *Ergeb. d. exakt. Naturwiss.* 13. *pp.* 257–309, 1934.—The literature is summarised under the headings: Introduction. Separation of the isotope: enrichment by electrolysis, diffusion and otherwise; natural occurrence of the isotope. Physical properties: D-atom; physics of the D-nucleus; molecules D_2 and HD. Compounds of the isotope: heavy water; other compounds. References to 186 original papers are given. T. H. P.

3982. Nomenclature of the Hydrogen Isotopes and Their Compounds. E. J. Crane. *Science*, 80. *pp.* 86–89, *July* 27, 1934.—This publication is an informal report by the Chairman of the Nomenclature, Spelling and Pronunciation Committee of the American Chemical Society. The following general viewpoints have been kept in mind: (*a*) the existence of many isotopes, (*b*) the fact that the isotopes of H are still forms of H and not new elements, (*c*) the effect of names and symbols on ease of thinking, (*d*) that of the teacher, (*e*) established nomenclature, (*f*) convenience, and (*g*) indexing. An effort has been made to see the picture as completely as possible and with the broadest view, but with H as a special case since it is a very common element and its compounds involve the whole field of organic chemistry. It is suggested that just the name hydrogen and its symbol H will serve in place of a special name and symbol for the isotope of mass 1. Protium and deuterium are favoured as names for the two isotopes with symbols H or H^1 and H^2 or D; the latter being considered a strong candidate for official use. A modified Boughton system is suggested for compounds containing H^2, *e.g.*, Benzene-d_4 is proposed instead of Boughton's benzene-f_2d_4 for $C_6H_2H^2_4$. The objection that the Boughton system mixes names and symbols is met by the precedents already in existence. H. H. Ho.

3983. Concentration of Deuterium by Electrolysis of Sulphuric Acid Solutions. T. Titani, K. Kurano and M. Harada. *Chem. Soc. Japan, Bull.* 9. *pp.* 269–271, *July*, 1934.—Sulphuric acid in water solution was electrolysed between lead electrodes until the volume was reduced to one half of the original volume. The acid was then neutralised with Na_2CO_3, distilled and then added to other cells of the same order of concentration, and the process repeated. The density of the final product was then determined. The electrolytic separation coefficient was calculated from the data obtained from a number of concentrations. F. J. B.

3984. Concentration of Deuterium by Electrolysis of Neutral Salt Solutions. T. Titani, K. Okaba and M. Harada. *Chem. Soc. Japan, Bull.* 9. *pp.* 272–273, *July*, 1934.—Deuterium was concentrated by the electrolysis of 0·25 *N* solutions of Na_2SO_4 in ordinary tap water. A nickel kathode and a lead anode were used as electrodes. 7 l. were concentrated to 134 c.c. and the final product contained 0·85 parts of H^2 in 1000. The use of neutral salts was found to possess two distinct advantages over acid or alkaline solutions. Neutralisation was not necessary after concentration, and the same electrolyte can be used throughout. A saving of time and labour was thereby effected. F. J. B.

3985. Isotopic Ratio in Hydrogen. Density of Water from Various Sources. H. J. Emeléus, F. W. James, A. King, T. G. Pearson, R. H. Purcell and H. V. A. Briscoe. *Chem. Soc., J. pp.* 1207–1219, *Aug.*, 1934.—Samples of water from over 70 sources including natural waters, ice, hydrated mineral salts, vegetable juices, animal secretions, and industrial processes, were purified very carefully and their density was determined relative to a certain standard by the method of flotation. Full details of the methods of purification and of the technique of the density determinations are given. The standard of density selected after much trial was water drawn from the London mains and purified. This remained constant within experimental error ($\pm 2 \times 10^{-7}$ gm./ml.) throughout the seven months of observation. Conductivity water was not used as a standard because it showed variations many times greater than this. The majority of the natural samples had densities near to that of the standard but some showed differences therefrom of as much as 86×10^{-7} gm./ml. Samples from industrial processes not involving electrolysis showed maximum deviations of -50 to $+46 \times 10^{-7}$ gm./ml. Waters from electrolytic plants showed larger variations, one of 300×10^{-7} gm./ml. being found. In every sample examined the deviation of the observed density from the standard is accounted for qualitatively by the operation of some physical or chemical process capable of changing the isotopic ratio in the appropriate direction. Distillation, freezing and melting and adsorption were all shown to be capable of producing such separation of isotopes. Combination in salt hydrates produced no such separation. P. H. B.

3986. X-Ray Diffraction Curves of Water and Deuterium Oxide at 25° C. G. W. Stewart. *J. Chem. Phys.* 2. *pp.* 558–559, *Sept.*, 1934.—The difference in freezing-point temperatures, maximum densities and molecular volumes and other physical constants of water and deuterium oxide indicate that the molecular forces do not remain entirely invariant with the isotopic change in mass. A comparison of the diffraction of X-ray curves for the two substances at 25° C. indicates that the liquid structure of deuterium oxide is much like that of water. The peaks in the deuterium oxide curve are slightly sharper, apparently explicable in the fact that, at 25° C., this substance, compared with water, is nearer to its freezing point. AUTHOR.

3987. Indium Isotope, In^{113}. M. Wehrli. *Helv. Phys. Acta*, 7. 6. *pp.* 611–619, 1934. *In German.*—From absorption photographs of the spectrum of the vapour of indium iodide 11 further indium isotope splittings have been obtained. Their theoretical valuation which the measurement of new edges of bands affords, proves the existence of In^{113}.

The intensity relationship of the edges of the bands corresponds qualitatively to the proportions of mass determined from the atomic weight: In^{115} : In^{113} = 11 : 1. A table is given of the newly measured, or newly arranged, edges of the bands from 4226·68 to 4486·04 Å, and also details of the isotope cleavages. J. J. S.

3988. Isotope Research. J. Mattauch. *Phys. Zeits.* 35. *pp.* 567–621, *Aug.* 1, 1934.—This paper takes the form of a comprehensive report and summary of the various methods employed in the investigation of isotopes and a review of the principal results attained. The scope of the report is indicated by the following sub-titles: 1. Introduction. 2. Methods of canal ray analysis: (*a*) parabola methods; (*b*) Aston's velocity focussing; (*c*) direction focussing; (*d*) velocity filter; (*e*) multiple acceleration; (*f*) direction and velocity focussing. 3. Spectroscopic methods: (*a*) isotope displacement in band spectra; (*b*) isotope displacement in line spectra. 4. Results: (*a*) summary of methods; (*b*) table of isotopes; (*c*) attempts to discover systematic relationships between isotopes. The report ends with a list of about 260 references to the literature on this subject. J. E. K.

3989. Excitation of Neutrons from Beryllium. L. Emo. *N. Cimento,* 11. *pp.* 357–360, *June,* 1934.—Using a high pressure ionisation chamber containing methane at 17 atmospheres the ionisation due to neutrons emitted from thin Be sheet placed near 15 m-Curie equivalent of Po, was measured. The air pressure between the Po and the Be was varied to give the particles an effective range from 40 to 35 mm. air equivalent at N.T.P. and the ionisation produced by the corresponding neutrons was found to decrease steadily. No maxima were found nor in a second series of experiments in which the effective range was 15·5 to 8·2 mm. was any resonance level of the Be nucleus observed. F. C. C.

3990. Energy Spectra of Neutrons from the Disintegration of F, B and Be by α-Particles. T. W. Bonner and L. M. Mott-Smith. *Phys. Rev.* 46. *pp.* 258–267, *Aug.* 15, 1934.—By using an expansion chamber filled with H_2 or CH_4 at a pressure of about 15 atmospheres, range-distribution curves have been obtained of the recoil protons from Po-F, Po-B, and Po-Be neutrons. These curves revealed the presence of numerous groups of neutrons in the radiation from the three sources. In the case of Po-F five neutron groups were found. These were fitted into a disintegration scheme, made by assuming that the α-particle enters the nucleus through resonance levels and by using the energies of these levels, which are known from the disintegration of F with proton emission. For Po-B eight groups were detected, but it was not possible to arrange a disintegration scheme. The maximum energy of the neutrons from Po-B was found to be 4·2 M.E.V., a value considerably higher than the previously accepted figure, 3·3 M.E.V. This value decreases the mass of the neutron calculated from the disintegration of B^{11} from 1·0067 to 1·0058. It is suggested that it is possible to explain the high value, 1·0098, obtained by Curie and Joliot from the disintegration of B^{10}, by assuming that both B^{11} and B^{10} emit neutrons. If the maximum energy of the neutrons from B^{10} were about 7·5 M.E.V. it would bring this mass into agreement. Reasons are given for believing that at least 10 times as many neutrons come from B^{11} as from B^{10} so that there may be a few as yet undetected neutrons from B^{10} extending up to this energy. About 22 groups were found in the neutron emission of Po-Be. A possible scheme of disintegration is given. AUTHORS.

3991. Valency Angle of Oxygen. G. M. Bennett, D. P. Earp and S. Glasstone. *Chem. Soc., J. pp.* 1179–1180, *Aug.*, 1934.—It has already been shown [see Abstract 875 (1934)] that the large dipole moment (1·5 D) of thianthrene implies that the valency bonds of S make an angle of less than 120° and consequently the natural valency angle of S is also less than 120°. Measurements have now been made in CCl_4, cyclohexane, and benzene solutions, which show that diphenylene dioxide, the analogue of thianthrene, has no appreciable dipole moment. This zero dipole moment indicates that the molecule is planar with an angle of about 120° between the O bonds; the minimum value for the natural valency angle of O in compounds of the same type must thus be 120°. Although there is evidence that in water, and As_2O_3 and Sb_2O_3 the O bond angle is 110° or less, yet an analysis of the dipole moments of some diphenyl ethers indicates that in these substances the angle is probably larger than the tetrahedral value (124°–132°). Since diphenylene dioxide may be regarded as a substituted diphenyl ether, the result of the present work is consistent with these conclusions. It is important to emphasise that there is no justification for supposing that the valency angle of O in other compounds is necessarily the same as in the diphenyl ethers. H. H. Ho.

3992. Chemical Linkage. Part I. Interpretation of Valency on the Basis of Wave-Mechanics and Band Spectra. R. F. Hunter and R. Samuel. *Chem. Soc., J. pp.* 1180–1186, *Aug.*, 1934.—Certain assumptions of current electronic theories of chemistry being physically unsound, the authors have applied knowledge obtained from band spectroscopy and wave-mechanics to the problem of valency and molecular structure; thereby obtaining a generalised theory in which many of the major difficulties are claimed to be explained. Fundamental wave-mechanical principles are first expounded both from the standpoints of London and Hund, and of Mulliken and Herzberg respectively, *viz.*, of the pair theory which explains the saturation of valency, and of the theory of molecular orbitals which can only accomplish this *via* further assumptions which are in reality generalisations of pre-wave mechanical theories. Two effects have to be considered in the formation of a molecule, *viz.*, the entry of electrons originating in different atoms into the same group in the molecule, which is of fundamental importance since on it depends whether chemical linkage can occur and how many linkages can be produced; superimposed is a second effect which depends on the fact that electronic groups may be bound in the molecule in an energetical order other than they possessed in the original atom and may influence the energy of the band as indicated by its heat of dissociation. The latter effect is insufficient to cause chemical combination. The authors then consider the octet rule, coordinate covalency, the semi-polar double bond, and the theory of the singlet linkage. Attention is next directed to certain cases, *e.g.*, the oxygen molecule, in which the octet theory appears to be formally correct, but leads actually to results which are inadmissible in the light of spectroscopic evidence. The theory of a single form of non-electrovalent linkage is then put forward, *viz.*, covalency, whose polarisation may vary anywhere between the limits of zero in the hydrogen molecule and that of a true salt consisting of atoms held together by electrostatic attraction; further, that chemical union consists always in the coupling of atoms by means of entry into the same group in the molecule of two electrons possessing antiparallel spin. It follows that: (*i*) any atom may act as a positive partner in chemical combination, a fact which is not obvious on the basis of current theory; (*ii*) the maximal number of "positive" valencies of an atom is equal to the number of electrons in its outer shell; (*iii*) the transition from covalency to electrovalency depends merely on the energy with which the electrons of the positive partner are held to its nucleus and the electronic affinity of the negative partner. It is claimed that the obvious difficulties with regard to valency numbers disappear, and that a closed group or sub-group residue which may or may not be a group of eight electrons should take the place of the octet. All the electrons of the sub-group become active together thereby explaining the phenomenon of saturation of valency. The paper has been confined to valency of the first order. H. H. Ho.

3993. Intramolecular Forces in Octahedral Molecules. A. Eucken and F. Sauter. *Zeits. f. phys. Chem.* 26. *Abt.B.* 6. *pp.* 463–472, 1934.—The calculation of the normal oscillations of an octahedral molecule based on the most general force assumptions compatible with its symmetry, has led to conclusions being drawn with respect to the intramolecular forces from the measured values of the normal oscillations of SF_6. H. H. Ho.

3994. Periodic Fluctuations of Labile Molecular Complexes about Their Equilibrium Position. L. Šplait. *Acta Physica Polonica,* 2. 4. *pp.* 459–464, 1934. *In German.*—The time-alteration of the Plotnikov longitudinal light-scattering effect has been investigated for mixtures of ethyl alcohol and water by means of an automatic registration method. Full details of apparatus and method are included. Periodic fluctuations have been established per half-hour as follows: 25 % alcohol, 15 periods; 20 %, 13; 10 %, 11; 5 %, 17; so that a minimum appears to exist for the 10 % solution. A probable interpretation of the phenomena is given by the assumption of a labile equilibrium of polymerised water molecules with alcohol. H. H. Ho.

3995. Thermal Data and Atomic Weight of Xenon. W. Heuse and J. Otto. *Phys. Zeits.* 35. *pp.* 628–629, *Aug.* 15, 1934.—Experiments similar to those already described for krypton [see Abstract 880 (1934)] are now reported for purified xenon. The quantities measured include the 0°-isotherm, the expansion and pressure coefficients, and the density at atmospheric temperature. From these data it is calculated that the atomic weight is $131 \cdot 22 \pm 0 \cdot 02$. R. W. P.

See also Abstracts **4018, 4033, 4061, 4064, 4076, 4132, 4184, 4204, 4238, 4253, 4266.**

COLLOIDS.

3996. Osmotic Properties of Colloidal Electrolytes and the Hammarsten Effect. P. van Rysselberghe. *J. Phys. Chem.* 38. *pp.* 645–652, *May,* 1934.—It is shown that, if the proper amount of association into micelles is taken into account, the low osmotic pressures observed for several colloidal electrolytes are qualitatively explained by the Debye-Hückel theory. The Hammarsten effect is not an unexpected abnormality.
AUTHOR.

3997. Coagulation of Hydrophobic Sols by Freezing. W. Heller. *Comptes Rendus,* 199. *pp.* 354–356, *July* 30, 1934.—The coagulation of sols by freezing is considered in relation to coagulation by mechanical agitation. Both require weakness of the electrical double layer. The results of Lottermoser on the reduction of stability of ferric-oxide sols with prolonged dialysis are confirmed. Below pH 6·1 freezing does not cause coagulation; the limit for mechanical coagulation is 6·5. Mechanical agitation, it is suggested, acts by increasing the velocity with which particles collide thereby causing added distortion of the electrical double layer. Freezing is supposed to affect the double layer in the same manner. [See Abstract 3092 (1934).] A. S. C. L.

3998. Coagulation of Egg-Albumen by Heat. H. R. Kruyt and J. R. de Jong. *Kolloid-Beihefte*, 40. 1–2. *pp*. 55–86, 1934.—Viscosity measurements have been made on dialysed egg-albumen sols at various temperatures. Between 0° and 20° C. the relative viscosity falls, this being regarded as due to diminution in the hydration of the protein particles. Between 20° and 90° C. the relative viscosity of the sols increases, most strongly with the iso-electric sols and less strongly with the electrically charged protein; this is ascribed to aggregation of the albumen particles. In the latter temperature range the protein undergoes chemical decomposition, which results in progressive decrease in the relative viscosity of the sol if this is kept at constant temperature; the results are corrected for this effect. If the pH value of the albumen sol is sufficiently far removed from the iso-electric reaction, the aggregation of the particles remains so small that the Hagen-Poiseuille law is obeyed. Egg-albumen sols partially dehydrated by addition of ethyl alcohol give results analogous to those obtained with heated sols. T. H. P.

3999. Viscosity Anomalies. M. Pichot. *Physics*, 5. *pp*. 200–206, *Aug*., 1934.—According to Buckingham and Bingham, the tractive forces involved in the flow of colloidal solutions are (i) pure viscous drag, $\delta F_1 = \eta(\partial v/\partial r)\delta s$, (ii) "structural friction," $\delta F_2 = a\delta s$ (independent of v or $\partial v/\partial r$), using the usual notation. For flow through a cylindrical capillary, this is shown to result in the existence of a central plug of liquid of radius r_0 moving with sectionally uniform velocity, r_0 being a function of a; the modified Poiseuille equation for the efflux is $Q = (p\Pi R^4/8\eta)\,[1 - (4r_0/3R) + (r_0/R)^4/3]$. The central "plug" is confirmed experimentally for 0·7 % gelatin sols, using Camichel's chronophotographic method. A theory is developed whereby η and a (or simple functions thereof) may be separately determined from the observed flow through a capillary under a pressure gradient decreasing with time; the theory is tested, with substantial confirmation, by experimental studies on sodium stearate solutions and the dependence of the structural coefficient on the history and age of the solutions is demonstrated. L. V. C.

4000. Diffusion of Electrolytes in Silica Gel. W. A. Patrick and B. W. Allan. *J. Phys. Chem.* 38. *pp*. 771–778, *June*, 1934.—Quantitative methods have been worked out for the preparation of impregnated gels of silicic acid. The anomalous effect of acid on the washing of such gels has been observed and an explanation has been advanced to account for the behaviour. Methods of preparing discs of silica gel, which permit the drying of such discs without shattering, have been discovered. The diffusion of salts and acids has been studied in hydrated silica gel. AUTHORS.

See also Abstract 4045.

CRYSTAL STRUCTURE AND PROPERTIES.

4001. Structure of Real Crystals. E. Orowan. *Zeits. f. Physik*, 89. 11–12. *pp*. 774–778, *July* 13, 1934.—A reply to Zwicky [see Abstract 2701 (1934)]. F. J. W.

4002. Recrystallisation Processes. H. G. Müller. *Phys. Zeits*. 35. *pp*. 646–649, *Aug*. 15, 1934.—The results of experiments on the dependence of the velocity of recrystallisation of NaCl at various pressures, and of the electrolytic conductivity on the temperature show that recrystallisation possesses the character of an auto-diffusion process and that during the formation of the recrystallisation nucleus no special nucleus-formation occurs. The results are probably of general applicability. T. H. P.

4003. Disposition of Work Energy Applied to Crystals. C. G. Maier and C. T. Anderson. *J. Chem. Phys.* 2. *pp.* 513–527, *Aug.*, 1934.—There are only two obvious possibilities ; either the heat produced is equal to the applied work, in which case there is no change in intrinsic energy, or only a fraction of the work appears as heat, in which case the intrinsic energy increases. Experiments are described upon fine and coarse calcite, to reveal differences in intrinsic energy due to comminution ; also tests of specific heats at low temperatures. F. I. G. R.

4004. Tensors and Crystal Symmetry. C. Hermann. *Zeits. f. Krist.* 89. *pp.* 32–48, *Aug.*, 1934.—A method is obtained by which the influence of the symmetry elements upon the tensor components is derived. A system of determinants follows, which can be made of practical use by a suitable choice of axes. F. I. G. R.

4005. Influence of Crystal Forces on Vibration of a Complex Ion. M. Blackman. *Phil. Mag.* 18. *pp.* 425–433, *Sept.*, 1934.—The frequency may be influenced by the surroundings of a complex molecule : a frequency shift may occur in consequence of a coupling of the " inner " vibration to the " lattice " vibrations. An analysis shows that this latter coupling gives rise to effects of the observed order of magnitude. F. I. G. R.

4006. X-Ray Examination of Calcium at High Temperatures. L. Graf. *Phys. Zeits.* 35. *pp.* 551–557, *Aug.* 1, 1934. *From the Reichsanstalt.*—Further X-ray examination of samples of Ca, some very pure, at temperatures up to 500°, and consideration of results obtained previously and by others, of the variations of dilatation and electric resistance with temperature and degree of purity show three transformations : (1) above 450°, when quite pure Ca shows hexagonal close packing, but with the presence of impurities more and more of the body-centred cubic form ; (2) at 300° with production of a lattice type stable up to 450° but not yet determined, and marked by change in electric resistance ; and (3) at 218° evidenced by change in physical properties, and only observed in the purest Ca. C. A. S.

4007. Structure of Tl-Bi Alloys. A. Ölander. *Zeits. f. Krist*, 89. *pp.* 89–92, *Aug.*, 1934.

4008. Colour and Crystal Structure of Cadmium Sulphide. W. O. Milligan. *J. Phys. Chem.* 38. *pp.* 797–800, *June*, 1934.—Either cubic β CdS or hexagonal α CdS may be yellow or red, depending upon the physical character of the precipitate. The β CdS tends to be precipitated from $CdSO_4$ solutions, and under some conditions from the nitrate solutions, especially if the latter are hot and distinctly acid in reaction. The α CdS tends to be precipitated from the chloride, bromide, and iodide solutions, but these precipitates may also contain some of the β modification. The lattice constants found for the two modifications of CdS agree within experimental error with those of Ulrich and Zachariasen. AUTHOR.

4009. X-Ray Spectra of $MnSO_4$ and its Hydrates. F. Hammel. *Comptes Rendus*, 199. *pp.* 282–283, *July* 23, 1934.—Powder photographs of five specimens of $MnSO_4,H_2O$ hydrated by different methods show no difference in structure, leading to the conclusion that isomeric forms of the monohydrate do not exist. A new hydrate having a composition $MnSO_4,3\cdot5H_2O$ is reported having properties distinct from the tetrahydrate, but both these hydrates and $MnSO_4,5H_2O$ have practically identical X-ray spectra. The monohydrate and anhydrous $MnSO_4$ however have distinctly different spectra. J. E. R. C.

4010. Cæsium Nitrate and the Perovskite Structure. L. Waldbauer and D. C. McCann. *J. Chem. Phys.* 2. *pp.* 615–617, *Sept.*, 1934.—The crystal structure of dysanalyte has been verified. The crystal structure of $CsNO_3$ has been determined. The so-called perovskite structure as a type of cubic symmetry is based on a mineral which is very probably not cubic but is orthorhombic. The term " perovskite structure " should be discontinued. AUTHORS.

4011. Electron Diffraction with Aluminium Silicates and other Substances of the Layer Lattice Type. F. Trendelenburg and O. Wieland. *Wiss. Veröff. a. d. Siemens-Konzern,* 13. 3. *pp.* 31–41, 1934.—In extension of previous work on graphite [see Abstract 823 (1934)], the X-ray and electron diffraction at crystal powders of a number of other substances crystallising in layer lattices (kaolin, pyrophyllite, agalmatolite, talc, magnesium hydroxide, lead iodide) have been examined. As with graphite, fundamental differences occur in the relative intensity distribution of the lines of different indication of the X-ray and electron plates. The differences arise from the varying condition of the surfaces in the different crystallographic orientations. Surfaces parallel to the directions of ready cleavage are electron-optically smooth, and sharp space-lattice interferences of high intensity do not occur at such surfaces under electron-radiation. On the other hand, substances showing not such good cleavage (like calcite) and those exhibiting no directions of preferred cleavage (like quartz) reveal no fundamental differences in the intensity distribution of the two kinds of rays ; the surfaces of these substances are always electron-optically rough. T. H. P.

4012. Electron Diffraction Photographs of Graphite. G. Aminoff and B. Broomé. *Zeits. f. Krist.* 89. *pp.* 80–85, *Aug.*, 1934.—Electron diffraction photographs showing spots and Kikuchi lines were obtained by passing rapid electrons through graphite. The former, assuming $a=2\cdot46$ Å (as determined by X-rays), give an effective wavelength of the electrons of $0\cdot0485$ Å [see Abstract 5054 (1933)], and $c=6\cdot3$ Å (X-rays give $6\cdot8$ Å). Deductions from the second photograph are in good agreement with X-ray results, and support the current theory regarding the Kikuchi lines. [See Abstracts 1273 (1929) and 1191 (1933).] C. A. S.

4013. Change in Form of Graphite Crystals on Burning. Nathalie Bach and I. Lewitin. *Kolloid Zeits.* 68. *pp.* 152–157, *Aug.*, 1934.—The changes in form of crystals of Ceylon graphite during their combustion in CO_2 under various conditions have been followed microphotographically. In pure graphite only the unsaturated edge-atoms of the hexagonal basic faces are capable of reaction, so that these surfaces are not attacked in the middle by CO_2. Ash constituents of natural graphite and potassium introduced into the graphite lattice catalyse the reaction with CO_2 at 1000° C. In this case holes and depressions are formed on the crystals about the catalyst nucleus during the combustion. When the combustion is carried out in a mixture of CO_2 and HCl the holes are hexagonal, but in pure CO_2 they are round or irregular. Hence, in the first case only those series of C atoms which are already attacked at one point burn the more readily, whereas in the second case the reactability of the different C atoms at the graphite-catalyst boundary is not markedly dependent on the mode of combination of the atoms. T. H. P.

4014. X-Ray Diffraction Study of Carbon Black. B. E. Warren. *J. Chem. Phys.* 2. *pp.* 551–555, *Sept.*, 1934.—X-ray diffraction patterns of carbon black have been made with strictly monochromatic radiation. Without making any assumptions as to the crystallinity of the material, the distribution of atoms about any one atom has been determined directly from the experimental scattering curve by the method of Fourier integral analysis. The results indicate definitely the existence of single graphite layers. Whether these layers have definite orientation and position with respect to one another (graphite crystal) or whether carbon black is a mesomorphic form of carbon, cannot be definitely decided from the experimental results. It is probable that carbon black is a heterogeneous mixture of particles which range from single graphite layers up to graphite crystals several layers thick. The intense small angle scattering is due to the difference between grain density and average density, caused by the loose packing of the extremely small grains. AUTHOR.

4015. X-Ray Diagrams of Peranthracites and True Anthracites. P. Corriez. *Comptes Rendus*, 199. *pp.* 410–412, *Aug.* 6, 1934.—Powder diagrams of three samples of true anthracite and of five of peranthracite from various localities all show two rings, A_1 and A_2. A_1 is of practically the same size for all the samples, and closely resembles that shown by graphite. A_2 steadily increases from slightly larger than A_1 to about three times its size, the order being that of increasing volumes of gas emitted by the same weight of samples when heated at 1000°. All samples show a felted structure, the resemblance to graphite being more marked as the volume of gas emitted on heating is less. C. A. S.

4016. Structure of Tetramethyl Ammonium Fluosilicate. R. B. Corey. *Zeits. f. Krist.* 89. *pp.* 10–17, *Aug.*, 1934. *In English.*—Laue and oscillation photographs show that the tetragonal unit cell of $[(CH_3)_4N]_2SiF_6$ contains two molecules and has the dimensions $a_0 = 7{\cdot}88$ Å, $c_0 = 11{\cdot}19$ Å. The space group is C^5_{4h} with Si at (*a*) F at (*e*) and (*h*), N at (*d*) and methyl occupying general positions (*i*). The atomic parameters were determined from spectrometric measurements of reflections from all (*hk*0) and (*h*0*l*) planes for which $2\theta <$ ca. 100°. Best agreement was obtained when the following parameters were assigned to F and methyl: F at (*h*): $u = 0{\cdot}18$, $v = 0{\cdot}12$; F at (*e*): $u' = 0{\cdot}155$; CH_3 at (*i*): $x = 0{\cdot}14$, $y = 0{\cdot}47$, $z = 0{\cdot}175$. The structure is a distorted fluorite arrangement of SiF_6 groups and $(CH_3)_4N$ tetrahedra. Interatomic distances agree well with those previously determined in other compounds. AUTHOR.

4017. Structure of Dibenzyl. Part I. Experimental and Structure by Trial. J. M. Robertson. *Roy. Soc., Proc.* 146. *pp.* 473–482, *Sept.* 1, 1934.—An X-ray investigation of the crystal structure of dibenzyl is described. The space group is $P2_1/a$, and the two molecules in the unit cell each possess a centre of symmetry. Quantitative intensity measurements have been made of the reflections from about a hundred crystal planes. In the analysis of the structure it is shown that the molecule extends in three dimensions instead of being planar as in the aromatic compounds already examined. The planes of the benzene rings, though parallel to each other, are at right angles to the plane containing the zig-zag of the connecting CH_2 groups. The orientation of this molecule

in the crystal has been determined and is given. The relation with Krishnan's work on the magnetic susceptibilities of the crystal is discussed.
AUTHOR.

4018. Adsorptive Incorporation and Mixed-Crystal Formation. A. Smekal. *Phys. Zeits.* 35. *pp.* 643–646, *Aug.* 15, 1934.—For NaCl and KCl, the deciding factor for complete gap-free miscibility lies in the energy relationships and not in numerical approximation of the lattice constants. The latter may, in some cases, be of primary importance in phenomena of reciprocally orientated separation and isomorphous intergrowth of two substances, as is often observed with non-miscible substances. Non-mixed-crystal incorporation of small proportions of foreign substances may be of adsorptive character. Two independent characteristics exist for the incorporations of adsorptive and mixed-crystal types, namely, localisable or non-localisable electron-formation in the foreign atom, and formation or absence of gap in the crystal lattice in the neighbourhood of the foreign atom. Sodium chloride crystals show purely mixed-crystal incorporation with KCl, purely adsorptive incorporation with $SrCl_2$, and both types together with AgCl. T. H. P.

4019. Equilibrium of Small Crystals. Part III. I. N. Stranski and R. Kaischew. *Zeits. f. phys. Chem.* 26. *Abt.B.* 4–5. *pp.* 312–316, 1934.—It is shown that the Gibbs-Wulff condition, according to which the central distances in the equilibrium form are proportional to the related specific surface energies, coincides with the property that the ϕ-values must be equal for all surfaces of the equilibrium form. The equilibrium forms experimentally established are classified and compared with the theoretical deductions. In the case of zinc there is complete agreement between the calculated and experimentally established forms; whereas theory requires the presence or absence of the two faces $11\bar{2}0$ and $10\bar{2}2$, Straumanis has established a case where only $11\bar{2}0$ appears, and this is opined to be due to a specific adsorption of hydrogen at the face $11\bar{1}0$. [For Parts I and II see Abstract 2714 (1934).] H. H. Ho.

4020. Kinetic Derivation of the Velocity of Nucleus Formation. R. Kaischew and I. N. Stranski. *Zeits. f. phys. Chem.* 26. *Abt.B.* 4–5. *pp.* 317–326, 1934.—Starting from the assumption of a stationary current of constant supersaturation, a kinetic derivation of the velocity of nucleus formation is given for the following three cases: (1) liquid nuclei from supersaturated vapour; (2) crystal nuclei (with simple cubic lattice) from supersaturated vapour; (3) gaseous nuclei from superheated liquid. In all three cases the expressions for the above velocity contain the factor $e^{-F\sigma/3kT}$, as first derived by Volmer, wherein $F\sigma/3$ is the work of nucleus formation. H. H. Ho.

4021. Separation of Crystals and Gases from Supersaturated Solutions. R. Fricke. *Kolloid Zeits.* 68. *pp.* 165–168, *Aug.*, 1934.—The favourable effect of uncharged adsorptive surfaces on the formation of crystal- or gas-nuclei under supersaturated solutions, and the corresponding effect of non-wetted surfaces on the separation of gases, are discussed. For a practical case the minimum values of the gas-nuclei required for stability are estimated. T. H. P.

4022. Transformation of Ammonium Salts. J. Fock. *Zeits. f. Physik*, 90. 1–2. *pp.* 38–43, *July* 24, 1934.—Measurements of sodium and potassium sulphates between 2 and 17μ at room-temperature and at − 80° C. have been made. No transformation similar to that reported for ammonium sulphate has been observed. It is to be concluded then that the effect observed with ammonium sulphate arises from a coupling between the NH_4 and the SO_4''. A new absorption band for SO_4'' at 10μ is reported. W. R. A.

4023. Temperature Variation of the Strength of NaCl Crystals. D. Mahnke. *Zeits. f. Physik,* 90. 3–4. *pp.* 177–188, *Aug.* 10, 1934.—The tensile strength of synthetic NaCl crystals, under maintained load, and in a direction perpendicular to the cubic planes, is found at temperatures between − 190° and 765° C. The variation is very similar to that found for "static" tensile strength; and there appears to exist a maximum strength near 650° C. At lower temperatures than this, an increase in the rate of deformation tends to reduce the strength, while at temperatures above 650° C., faster deformation increases the strength. The temperature variation of the plastic properties of NaCl is very similar to that of metal crystals. J. P. A.

4024. Tensile Properties of NaCl Crystals. S. Dommerich. *Zeits. f. Physik,* 90. 3–4. *pp.* 189–196, *Aug.* 10, 1934.—The elastic limit under tension for uniformly dissolved NaCl crystals is found for loading in 14 different directions all lying in a rhombododecahedral plane. When the direction of load makes with the (110) direction an angle smaller than 21° or larger than 48°, plastic deformation takes place along the rhombododecahedral slip planes. For all other directions it proceeds along the cubic planes. In all cases the shear stress law of Schmid is confirmed. J. P. A.

4025. Elastic Properties of Quasi-Isotropic Multiple Crystals. A. Huber and E. Schmid. *Helv. Phys. Acta,* 7. 6. *pp.* 620–627, 1934. *In German.*—From the dependence on orientation of the modulus of elasticity and the modulus of torsion of cubic and hexagonal crystals the moduli of the irregular quasi-isotropic multiple crystal are calculated by formation of average value over the whole range of orientation. J. J. S.

4026. Calculation of Physical Constants of Quasi-Isotropic Multiple Crystals. W. Boas and E. Schmid. *Helv. Phys. Acta,* 7. 6. *pp.* 628–632, 1934. *In German.*—The method described by Huber and Schmid [see preceding Abstract] for calculating the elastic moduli of quasi-isotropic multiple crystals from the behaviour of the single crystal has been verified by being applied to a series of metals, and by comparison with other methods of obtaining the average. The transfer of the method to the determination of other constants such as the coefficient of extension and the specific electric resistance leads also to satisfactory results. J. J. S.

4027. Latent Energy Due to Lattice Distortion of Coldworked Copper. W. A. Wood. *Phil. Mag.* 18. *pp.* 495–505, *Sept.,* 1934.—The lattice dimensions of cold-worked and normal copper are compared with the aid of a precision X-ray camera. It is shown that the process of working produces an irregular expansion of the lattice. The expansion is interpreted in terms of the equivalent heat energy required to produce a similar state. The conception of a latent energy due to lattice distortion is advanced; its magnitude for the case of copper is deduced from measurements on the broadening and shift of the X-ray spectral lines. AUTHOR.

4028. Fourier Integral Analysis of X-Ray Powder Patterns. B. E. Warren and N. S. Gingrich. *Phys. Rev.* 46. *pp.* 368–371, *Sept.* 1, 1934.—A method is developed for the harmonic analysis of X-ray powder patterns. From the experimental scattering curve a radial distribution function is obtained, giving the number of atoms to be found at any distance from a given atom. As an illustration, the method is applied to the pattern of rhombic sulphur. A radial distribution curve is obtained which indicates that each atom has two nearest neighbours at a distance of about 2·3 Å. The result is in good agreement with the chemist's picture of an S_8 ring molecule. AUTHORS.

4029. Fourier Series Method for the Determination of the Components of Interatomic Distances in Crystals. A. L. Patterson. *Phys. Rev.* 46. *pp.* 372–376, *Sept.* 1, 1934.—A method for the direct determination of the components of interatomic distances in crystals has been developed from a consideration of the properties of the Fourier series whose coefficients are the squares of the F-coefficients for the crystal reflections. Valuable structural information is thus obtained without making any assumptions as to the phase to be allotted to the F-coefficients. The practical application of the method is illustrated by a discussion of the structures of potassium dihydrogen phosphate and hexachlorobenzene.

AUTHOR.

4030. Surface Magnitude and Lattice Changes of Crystallised Salts by Hahn's Emanation Method. F. Strassmann. *Zeits. f. phys. Chem.* 26. *Abt. B.* 4–5. *pp.* 353–361, 1934.—The surface of barium nitrate, calculated from the emanating power, agrees well with that measured under the microscope. Marked diffusion of the emanation from the barium nitrate crystals was detected. For the eutectic KNO_3–$Ba(NO_3)_2$, a reaction in the solid state at room-temperature was observed by means of the emanation method. T. H. P.

4031. Lattice Structure and Gas Penetrability of Organic Salts by Hahn's Emanation Method. F. Strassmann. *Zeits. f. phys. Chem.* 26. *Abt. B.* 4–5. *pp.* 362–372, 1934.—By means of a number of examples, it is shown that the emanating power of barium salts of organic acids is influenced greatly by the structure of the salts. A new method is developed for determining the emanating power of thoron, the method being applicable even with very low emanating powers. T. H. P.

See also Abstracts **4070, 4185, 4188, 4226, 4232, 4233, 4257, 4309, 4311, 4312, 4313, 4314, 4338.**

DENSITY.

4032. Vapour Density Determinations by an Optical Method. M. Weiss. *Ann. d. Physik,* 20. 5. *pp.* 557–568, *Aug.,* 1934.—Based on the fact that the molecular refraction of a gas is independent of the pressure within wide limits, a method for the determination of the vapour density of gases and vapours has been developed, which enables measurements at higher temperatures within an accuracy of 1 %. Data are given for air, carbon dioxide, ether, ethyl chloride and ethyl nitrite at 20° and 100° C. The molecular refractions and polarisations of the above substances together with benzene are included. The influence of the absorption layer on vapour measurements is discussed at length, and certain deviations of the present data from those previously recorded are thereby explained.

H. H. Ho.

4033. Sensitive Method for Measuring Small Differences in Density of Liquids, Especially Water. H. Moser. *Phys. Zeits.* 35. *pp.* 682–683, *Sept.* 1, 1934. *From the Reichsanstalt.*—A reliable and reasonably quick method of determining small density differences. A cylindrical glass sinker of volume about 30 ml. floats submerged in a vertical tube containing the sample whose density is required. It is tethered from below by a fine platinum-iridium spiral such that a change in load of 1 mg. produces an extension of 0·05 mm. The lower end of the spiral is attached to a framework which supports the sinker when the latter is not immersed, and carries a short platinum wire pointing downwards just above a similar wire pointing upwards at the top of the sinker. The distance between the two vertical wires is observed at measured temperatures. The difference between the densities of samples of water placed successively in the tube is deduced from the empirical relation that a change of 1 mm. in the separation of the wires corresponds to a change of 0·149° C. in the water temperature. An accuracy of $\pm 6 \times 10^{-7}$ gm./ml. is attained. P. H. B.

See also Abstracts **3985, 3995, 4226.**

DIFFUSION AND OSMOSIS.

4034. Diffusion of Water in a Zeolite Crystal. Mobility of Adsorbed Molecules. A. Tiselius. *Zeits. f. phys. Chem.* **169.** *Abt.A.* **5–6.** *pp.* **425–458, 1934.**—The changes in the optical properties of a dehydrated zeolite caused by changes in water content make it possible to observe directly the diffusion of water into such a crystal. Using this method the influence of concentration, pressure, temperature and direction on the rate of diffusion of water into heulandite has been studied. The diffusion constant is very sensitive to changes of concentrations at low concentrations of water and this is in agreement with the adsorption isotherm. The diffusion is strongly anisotropic. The activation energy for diffusion is 5,400 cal. for the 201 and $\bar{2}01$ planes, and 9140 cal. for the 001 planes. This may be compared with a sorption heat of 12,000 – 18,000 cal. F. J. W.

See also Abstracts **3996, 4000, 4365.**

ELASTICITY AND PLASTICITY.

4035. Three-Dimensional Problem in Elasticity. H. Neuber. *Zeits. f. angew. Math. u. Mechanik,* **14.** *pp.* **203–212,** *Aug.,* **1934.**—It is shown that the three components of elastic displacement may be obtained by differentiation of four harmonic functions, instead of by an integration, as necessary heretofore. The corresponding system of equations is easily transformed to curvilinear coordinates. The three-dimensional problem may then be solved generally by setting one of the functions equal to zero. As an example, the distribution of stress in a hollow cone, loaded at one point, is fully worked out. J. P. A.

4036. Compressibility of Dilute Electrolyte Solutions. A. Szalay. *Phys. Zeits.* **35.** *pp.* **639–643,** *Aug.* **15, 1934.**—An apparatus is described for measuring the compressibility of dilute electrolyte solutions with the help of the Debye-Sears optical diffraction phenomena using supersonic vibrations of wave-length of the order of a few tenths of a mm. Various electrolyte solutions are employed. The results show a linear rise of sound velocity with ionic concentration in water. From this effect, the effect on the compressibility is calculated by means of the Newtonian formula $c^2 = 1/\beta s$ where β is the compressibility defined by $\beta = (-dv/v) \cdot (1/dp)$, s is the specific gravity and c the velocity of sound. It is shown that ions with the same charge have approximately the same effect, that the effect increases more than linearly with polyvalent ions but not quadratically and that the compressibility decreases linearly with increasing concentration. The theory suggested by Debye but not yet published predicts satisfactorily the sign, linearity and magnitude of the effect. A brief interpretation of the results is given. R. L.

4037. Mechanics of Isotropic Bodies in the Plastic State. H. Geiringer and W. Prager. *Ergeb. d. exakt. Naturwiss.* 13. *pp.* 310–363, 1934.—The present state of knowledge in this field is summarised under the headings: Introduction; conditions of flow; relation between stress and change of shape; statistically defined problems with Saint-Venant-Mises bodies; complete problem in the plane case; literature—38 references. T. H. P.

4038. Rheological Properties of Asphalts. Part I. Effect of Temperature. C. U. Pittman and R. N. Traxler. *Physics,* 5. *pp.* 221–224, *Aug.,* 1934.—It is pointed out that the flow characteristics are probably among the most important of the physical properties of bitumens and mixtures containing them. The authors describe in this connection the Bingham-Stephens method and a tube method based on the Bingham-Murray plastometer. Identifying data, namely, penetration, float, softening point and ductility are given for six different types of asphalt. J. K.

4039. Vibration of Buildings during Earthquakes. M. Biot. *Zeits. f. angew. Math. u. Mechanik,* 14. *pp.* 213–223, *Aug.,* 1934. *In English.*—A proof is first given of a theorem which states that when an arbitrary horizontal acceleration $j_0\psi(t)$, of finite duration acts on a building, the resulting vibration at the end of the impulse is composed of a series of free oscillations; and which shows how the amplitudes of these free vibrations are related to the "spectral distribution" of $\psi(t)$. The theorem is then applied to the case of a building with an elastic first storey. J. P. A.

See also Abstracts 3995, 4027, 4077, 4117, 4118, 4280.

GRAVITATION.

4040. Gravity Values on an Ellipsoidal Geoid. C. Somigliana. *Accad. Sci. Torino, Atti,* 69. 1. *Disp.* 3. *pp.* 345–357, 1934.—Starting from the general solution of the gravitational problem for an ellipsoidal geoid, the linear relation which exists between any three values of gravity is determined. Values of the three relations between the gravity values at the ends of the three axes of the ellipsoid are found, and form an extension of the classical equation of Clairaut. W. A. R.

4041. New Askania Oblique Beam Torsion Balance. H. Imhof and A. Graf. *Beitr. z. angew. Geophys.* 4. 4. *pp.* 426–436, 1934. *Rev. Sci. Instruments,* 5. *pp.* 356–358, *Oct.* 1934.—The shifting of the zero point (traced to air currents caused by change of temperature), and slight axial vibration of the beam, the chief defects of the old forms are removed in the new in which the beam is oblique and suspension bifilar. Other improvements include reduction in total weight (to about 37·5 kg.), prevention of "sticking," lessened fear and easier remedying of maladjustment or dislocation, and easier erection and dismantling—all with no diminution in accuracy. The new instrument is figured and described. C. A. S.

HYDRODYNAMICS AND AERODYNAMICS.

4042. Action of a Current on a Hypocycloidal Profile with *n* Cusps. A. Masotti. *Accad. Lincei, Atti,* 19. *pp.* 789–793, *June* 1, 1934.—

Using the formulæ of Blasius, the author calculates the force system on a hypocycloidal profile due to the action of a current flowing past it. A. J. McC.

4043. Forces on Two Cylinders in a Uniform Stream of Fluid. Part I. D. Endô. *Phys. Math. Soc. Japan, Proc.* 16. *pp.* 275–287, *Aug.*, 1934. *In English.*—The forces acting on two cylinders placed in a uniform stream of an incompressible perfect fluid are calculated in terms of the bipolar co-ordinates and the results are discussed numerically.
AUTHOR.

4044. Laminar Motion of an Incompressible Viscous Fluid. J. Allen. *Phil. Mag.* 18. *pp.* 488–495, *Sept.*, 1934.—In laminar flow through a pipe of rectangular cross-section the ratio of maximum to mean velocity depends on the ratio of the lengths of the sides. Thus, for a square section the maximum velocity is 2·10 times the mean velocity; when one side is very long compared with the other the ratio tends to the value 1·5 as in steady flow between infinite parallel plates. Similarly, the position of filaments of mean velocity is shown to vary with the ratio $a : b$, where $a = \frac{1}{2}$ width and $b = \frac{1}{2}$ depth of the rectangular pipe; for a square section it may be found at points on the axes distant very nearly 0·375 of the length of the sides, from the centre. In a pipe having one side whose length may be regarded as infinite, the mean velocity occurs at points distant 0·289 of the total depth, measured from the transverse axis. In streamline flow along an infinitely wide open channel, the maximum velocity may be less than 1·5 times the mean—there is evidence to support a value of 1·34, the filament of mean velocity being then situated at 0·65 of the depth below the surface. AUTHOR.

4045. Rheologic Aspects of Petroleum Production. A. G. Loomis, H. A. Ambrose and H. T. Kennedy. *Physics*, 5. *pp.* 207–216, *Aug.*, 1934.—A critical review and summary are given of some of the rheological aspects of the production and transportation of petroleum. It is shown how the proper flow characteristics of the colloidal dispersions known as drilling fluids may be controlled by chemico-physical methods, and the importance of these characteristics in the technique of drilling is analysed. The laws of flow of gas-oil mixtures through porous media are approached by a study of the permeability factor of such media, and applied to the problems of ultimate production, production rate, effective drainage area, etc., of petroleum-producing horizons. The flow of gas-liquid mixtures through pipes is discussed from the standpoint of bringing oil to the surface from the reservoir. Pipeline flow of oil is discussed with particular reference to cold weather flow for oils that exhibit thixotropic properties because of a heavy content of wax. Unsolved problems in these various fields of the rheology of petroleum production are pointed out.
AUTHORS.

See also Abstracts 4099, 4100.

KINETIC THEORY OF MATTER.

4046. Scattering of Hydrogen and Helium Beams in Mercury Vapour. R. M. Zabel. *Phys. Rev.* 46. *pp.* 411–416, *Sept.* 1, 1934.—The scattering of beams of hydrogen molecules and helium atoms in mercury vapour has been investigated in the angular region from 5° to 65° at beam temperatures of 115°, 300° and 590° K. The results are expressed in terms of the number of molecules scattered per incident molecule, per cm. path, per 10^{-3} mm. of mercury at 0° C. per unit solid angle in the direction θ to the original beam. The general shape, the absolute intensity and the change in shape of the helium scattering curves with change in beam temperature is in moderately good quantitative agreement with the quantum theory of scattering of rigid spheres as developed by Massey and Mohr. The scattering of hydrogen molecules, especially at low temperatures, shows some deviation from the results predicted by the same theory. In the case of both hydrogen and helium it is necessary to assume collision radii larger than the corresponding kinetic theory values in order to obtain the best agreement between the calculated and observed curves. AUTHOR.

4047. Theory of the Brownian Movement. G. Krutkow. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 3. *pp.* 90–93, *July* 11, 1934. *In German.*—Works out the theory of the distribution of the phases, the velocities and the displacements of a free Brownian particle. [See following Abstract.] J. P. A.

4048. Special Case in the Theory of the Rotational Brownian Movement. G. Krutkow. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 3. *pp.* 156–162, *July* 21, 1934. *In German.*—The theory of the rotational Brownian movement of a rigid, axially symmetric particle, which has two of its principal moments of inertia equal, is worked out. This affords an example of a mathematically tractable case of the non-linear problem in Brownian motion. [See preceding Abstract.] J. P. A.

See also Abstracts 4178, 4198, 4255, 4316, 4319.

MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

4049. Bertrand Problem for Certain Curves of Generalised Conics. E. O. Lovett. *Comptes Rendus,* 199. *pp.* 514–516, *Aug.* 27, 1934.—This mathematical paper considers the forms given by Appell and Tisserand to Halphen's method for the revolution of the Bertrand problem, and investigates an analogous problem with respect to certain curves ϕm, ψn, which reduce to conics if $m = 2$, $n = 3$. ϕm are curves defined by the integrable equation, $d^3/dx^3[(d^2y/dx^2)^{-\frac{2}{m}} = 0$, and ψn are curves which satisfy the differential equations, $dx/dt = x^1$, $dy/dt = y^1$, $dx^1/dt = ux$, $dy^1/dt = uy$, $n^2u^2d^3u/dt^3 - 3n(n+1)u\, du/dt\, d^2u/dt^2 + (n+1)(2n+1)(du/dt)^3 - n^2u^3\, du/dt = 0$. The latter by means of the substitution $u = \psi^{-n}$ gives the integrable form $d^3\psi/dt^3 = \psi^{-n}\, dx/dt$, and when $n = 3/2$ this becomes Tisserand's equation corresponding to the first equation of Halphen. H. H. Ho.

4050. Determination of Error in the Störmer Method of Integration. G. Schulz. *Zeits. f. angew. Math. u. Mechanik,* 14. *pp.* 224–234, *Aug.,* 1934.—The method of Störmer for the approximate integration of the equation $dx^2/dt^2 = f(x, t)$ where $f(x, t)$ involves the first derivative dx/dt, is described, and the Störmer formula produced by a new method. The estimation of the error of a given solution is then fully considered, and a more general method of exact evaluation is given, which is equally suitable for systems of equations of the above form. J. P. A.

4051. Theory of Groups and Physics of Fields. G. Juvet. *R.G.E.* 36. *pp.* 147–160, *Aug.* 4, *and pp.* 192–199, *Aug.* 11, 1934.—The rapid progress of theoretical physics in coordinating and predicting the advance of experimental physics has to some extent overshadowed mathematical physics. Actually, the importance of the latter is as great as ever in the investigation of the structure and coherence of new theories. The author demonstrates the importance of group relations in deductive theories, taking examples of geometry, mechanics, relativity and unitary theories. His exposition leads from axiomatic and group conceptions, physical constants, successive approximations, Newtonian dynamics, fields of force and gravitation to Riemannian geometry and its application to gravitational problems, the geometrical nature of matter, cosmological theory and the form of space, and the unitary theories of gravitation and electricity. R. E. N.

See also Abstracts 4278, 4349.

MECHANICS, CLASSICAL.

4052. Movement of a Material Point on a Fixed Conical Surface. O. Pylarinos. *Accad. Lincei, Atti,* 19. *pp.* 704–707, *May* 20, 1934.—A discussion of the motion of a particle constrained to move on a fixed smooth conical surface and acted upon by a central force towards the vertex of the cone. A. J. McC.

4053. Small Oscillations of a Pendulum with Oscillating Point of Suspension. A. Erdélyi. *Zeits. f. angew. Math. u. Mechanik,* 14. *pp.* 235–247, *Aug.,* 1934.—It is shown that a pendulum whose point of suspension makes vertical oscillations, can execute oscillations about a mean position obliquely directed upwards, when the frequency of the point of suspension exceeds a threshold value designated the critical frequency, and that this depends on the amplitude of the point of suspension and on the damping of the system. A method has been developed which enables the calculation of the necessary data for a given amplitude of oscillation of the point of suspension and damping of the system, whereby the critical frequency as well as the equilibrium position can be determined for every frequency. Approximation formula for very small and very rapid oscillations of the point of suspension gave the Hirsch formula for no damping, and indicated that for the damped system there is a too small critical frequency and a too great equilibrium angle. The valid approximation formulæ for the damped system indicated, however, that with unlimited increase of damping the critical frequency exceeds all limits and stabilisation is no longer possible. H. H. Ho.

See also Abstract 4280.

MECHANICS, QUANTUM.

4054. Vacuum in Dirac's Theory of the Positive Electron. R. Peierls. *Roy. Soc., Proc.* 146. *pp.* 420–441, *Sept.* 1, 1934.—The problem of the charge and current induced in the vacuum by an electromagnetic field has been studied following Dirac's theory where the positive electron is a "hole" in an infinite distribution of electrons in states of negative energy. Owing to the use of infinite quantities the answer given to this problem by the simple theory is mathematically undefined and new assumptions are needed in order to make it definite. Several apparently natural assumptions have been discussed and it is found that even the most natural amongst them leads to a logarithmically divergent expression for the polarisability of the vacuum. It does not seem probable that this difficulty can be removed without making essential changes in the concepts underlying the theory. AUTHOR.

4055. Relativistic Theory of the Electron. T. Derenzini. *N. Cimento*, 11. *pp.* 309–328, *May*, 1934.—A brief resumé of Dirac's theory of the electron leading up to its most recent developments. A. J. McC.

4056. Wave Equation of a Body of Variable Mass. Applications to Radioactivity. J. J. Placinteanu. *Accad. Lincei, Atti*, 19. *pp.* 629–634, *May* 6, 1934.—The idea of a body whose mass varies with the time is realised perfectly in radioactive phenomena. Starting from the well-known equations of motion for a body of variable mass, due to Levi-Civita, a Schrödinger wave-equation is set up for such a body and it is found to lead to the same wave-equation as is reached by the Gamow theory of the emission of α-particles. A. J. McC.

4057. Wave Mechanics and Superquantification Leading to a General Mechanics. J. L. Destouches. *Ann. de Physique*, 2. *pp.* 5–159, *July–Aug.*, 1934.—The various quantum theories are examined with the object of establishing new general fundamental principles and axioms. Starting from the simple de Broglie wave mechanics the systems of Pauli and of Dirac and the quantum field theory are analysed with special reference to the space of the wave-functions. It is shown that all wave mechanics is equivalent to a " point " mechanics in wave-functional space. The theory of superquantification is developed rigorously with the help of abstract mechanics. A comparison of existing theories leads to the conclusion that in all of them use is made of abstract mechanics to varying extents, and that they possess many analogous or common properties. This indicates the possibility of a general " point " mechanics in configuration space. N. M. B.

4058. Hartree Fields of Carbon. C. C. Torrance. *Phys. Rev.* 46. *pp.* 388–390, *Sept.* 1, 1934.—A new method of integrating the Hartree equations for the charge distributions of the electrons in an atom is described and the wave functions for the ground state and the first excited state of carbon are tabulated. AUTHOR.

4059. Approximate Wave Functions for High-Energy Electrons in Coulomb Fields. W. H. Furry. *Phys. Rev.* 46. *pp.* 391–396, *Sept.* 1, 1934.—Approximate solutions are given of the Dirac equations for an electron in a Coulomb field of force, which reduce at large distances to plane waves. For very high-energy electrons these functions satisfy the wave equations to terms of the orders $(\alpha^2/r)\sin^2\theta/2$, $(\alpha^2/r)\sin\theta/2$. Thus they are everywhere at least as accurate as the functions obtained by first order approximation methods, and for $\theta \to 0$ they satisfy the equations exactly. They therefore give an improved method for treating problems in which high energy electrons are ejected in a narrow angular range. The functions are simple in form and quite similar to the Gordon-Temple solutions of the Schrödinger equation in parabolic coordinates. AUTHOR.

4060. General Statistical Method for an Assembly of Indistinguishable Particles. G. Allard. *Comptes Rendus*, 199. *pp.* 342–345, *July* 30, 1934.—An extension of the method of Planck is given for dealing with the statistics of an assembly of indistinguishable particles in quantum theory. The method gives, as special cases, both the Bose-Einstein and the Fermi-Dirac statistics. The theory throws some light on the conditions of validity of the Bose-Einstein partition formula, as well as on some other points. G. C. McV.

See also Abstracts **3992, 4175, 4198, 4289, 4296, 4333, 4335, 4337, 4349.**

RELATIVITY AND ETHER.

See **Abstracts 4049, 4152.**

SOLUTION.

4061. Liquid State. J. H. Hildebrand. *Science*, 80. *pp*. 125–133, *Aug*. 10, 1934.—Discussion of the effects of polarity of molecules upon their packing in the liquid state. A. S. C. L.

4062. Liquid Ammonia as a Solvent. Part II. H. Hunt and W. E. Larsen. *J. Phys. Chem.* 38. *pp*. 801–807, *June*, 1934.—The vapour pressures of solutions of ammonium nitrate, ammonium chloride, ammonium bromide, and ammonium iodide in liquid ammonia have been determined over as wide a concentration range as possible at 25° C. [See Abstract 5323 (1932).] AUTHORS.

4063. Solubility of Biphenyl in Non-Polar Solvents. J. C. Warner, R. C. Scheib and W. J. Svirbely. *J. Chem. Phys.* 2. *pp*. 590–594, *Sept.*, 1934.—The solubilities of biphenyl, between 30° and 60°, in benzene, carbon disulphide, carbon tetrachloride, heptane, dioxane and *p*-dichlorobenzene have been determined. The solubilities, in all cases, are lower than ideal. The freezing point-composition diagram for the system biphenyl-*p*-dichlorobenzene has been determined. These components yield a simple eutectic at 27·7° and at 42·5 mole percent biphenyl. Hildebrand's equation, based upon the simple Baud-Heitler equation for the heat of mixing, yields fairly satisfactory results for solutions of biphenyl in benzene, carbon disulphide, *p*-dichlorobenzene and dioxane. The results are not very satisfactory when the equation is applied to the solutions of biphenyl in carbon tetrachloride and heptane. Hildebrand's more recent equation, based upon the Menke probability function, yields fairly satisfactory results considering the nature of the assumptions made in its derivation. It is concluded that regular solution behaviour should be expected only when the molecules of the constituents, in addition to being non-polar, possess spherical symmetry. AUTHORS.

4064. Sedimentation Equilibria of Inorganic Salts in the Ultra-Centrifuge. K. O. Pedersen. *Zeits. f. phys. Chem.* 170. *Abt.A*. 1–2. *pp*. 41–61, 1934.—A thermodynamic derivation of the formula for the sedimentation equilibrium of electrolytes and non-electrolytes is given. It is pointed out that the determination of the concentration differences of a substance in solution at sedimentation equilibrium provides a new method for the determination of activity coefficients. A discussion is given of the refractometric method for the experimental determination of concentration gradients. An account of experiments with solutions of CsCl, CsI, KIO_3, $LiIO_3$, $TlNO_3$, $HgCl_2$, and CdI_2 then follows. A Svedberg ultra-centrifuge is used, the rate being 45,000 to 60,000 r.p.m., corresponding to a centrifugal field of $1\cdot5\times10^5$ to $2\cdot6\times10^5$ *g*. From the observed concentration gradients, determined by the refractometric method, values are calculated for the molecular weights of the solutes. Agreement with the true molecular weights to within about 10 % is obtained, except in the cases of CsCl and CdI_2. L. A. W.

See also Abstracts **3959, 3960, 3961, 4021, 4141, 4142, 4235, 4253, 4260.**

SURFACE TENSION AND COHESION.

4065. Theory of Imbibition. C. E. Guye. *Helv. Phys. Acta*, 7. 6. *pp.* 584–604, 1934. *In French.*—The equilibrium of a liquid soaking upwards into a vertical strip of blotting paper tends to be logarithmic. Formulæ previously put forward by the author only hold within narrow limits [see Abstract 1708 (1930)]. In the present paper the process of imbibition is treated (*a*) as a matter of simple diffusion, and (*b*) as a hydrodynamic phenomenon. The relations derived by (*b*) reduce in particular circumstances to those found by (*a*). They are in a form permitting experimental verification and are regarded as serving to guide renewed investigations. P. H. B.

4066. Surface Tension and Molecular Volume of Nitroglycerin. T. C. Sutton and H. L. Harden. *J. Phys. Chem.* 38. *pp.* 779–781, *June*, 1934.—The surface tension of nitroglycerin was determined by (*a*) Sugden's bubble-pressure method, (*b*) Kennedy's method, and (*c*) Sutton's method. The sample was purified until methods (*b*) and (*c*) gave substantially the same result as found by method (*a*), which was then accepted for calculation of the parachor. The determined parachor 379·3 agrees with the value 378·9 obtained from the standard constants deduced by Sugden. Also experimental data are given which show that the parachors of solutions of nitroglycerin and nitrobenzene are an additive property of the constituents. No support is given to the theory that the sensibility of an explosive is associated with a state of " strain " within the molecule. P. H. B.

4067. Surface Tension of Debye-Hückel Electrolytes. L. Onsager and N. N. T. Samaras. *J. Chem. Phys.* 2. *pp.* 528–536, *Aug.*, 1934.—It is shown that Wagner's theory of the increase in surface tension caused by the addition of strong electrolytes to water does not fully hold. For not too high concentrations, the variation of the radius of the " ionic atmospheres " with depth in accordance with the increased concentration of ions in the surface layers may be left out of account as a first approximation without further loss of accuracy. Convenient explicit formulæ derived on this simplified basis account reasonably well for the observed surface tensions up to 0·2 *N* concentration. The agreement obtained verifies Coulomb's law for univalent ions at distances greater than a molecular diameter from the surface, but at small distances the repulsion from the surface may be greater than expected. P. H. B.

4068. Monomolecular Dipole Layers. C. E. Guye. *Helv. Phys. Acta*, 7. 6. *pp.* 605–610, 1934. *In French.*—It is shown that the statistical force exerted near a circular layer of dipoles is generally considerably less than that exerted at the same distance by a single dipole. This is also true for several adjacent layers in which the dipoles have an average orientation gradually decreasing in proportion to the distance from the surface where orientation is a maximum. In both these cases the statistical force obtained by integration tends to decrease to zero as the radius of the layer increases. By adding together the forces due to each individual layer it is found that the total force does not vanish but is still small in comparison with that due to a single dipole. These considerations are of interest when considering the action of micelles on the surrounding medium. P. H. B.

4069. Mechanical Properties of Monomolecular Films. I. Langmuir. *Frank. Inst., J.* 218. *pp.* 143–171, *Aug.*, 1934.—Monomolecular films of many organic substances are easily produced on water, and the present paper includes a detailed study of the mechanical properties of such oil lenses containing stearic acid, in the hope that the methods worked out will lay the foundation for an exact thermodynamic analysis of the energy relationships of adsorbed films on water and on the interfaces between oil and water. Methods are described by which monomolecular oil films may be applied to glass surfaces, and also by which several layers of molecules may be so applied. The lubricating properties of monomolecular films are described and data assembled for providing eventually a proper explanation of the fundamental phenomena of lubrication. On the author's theory of expanded films it is indicated that such films should be regarded as duplex films having an upper and a lower surface, the latter being essentially an interface between a hydrocarbon and water. It would appear that the phenomena at the interface between oil and water should in many ways be simpler than those characteristic of monomolecular oil films on water, and a technique is described suitable for their study. The latter includes a very convenient method for measuring the thicknesses of thin films. Great emphasis is laid on the adsorbed films at the interface between oil and water, since these appear to possess far more practical significance than the films which can be formed at the surface between water and air. H. H. Ho.

4070. Structure of Monolayers of Myristic Acid. N. W. H. Addink. *J. Chem. Phys.* 2. *pp.* 574–577, *Sept.*, 1934.—Force-area (F/A) and surface-potential ($\Delta V/A$) curves have been determined for films of myristic acid on 0·01 *N* HCl for $A = 41Å^2$. For such areas there is a metastable liquid expanded film, which on standing slowly passes into the stable form, which is definitely homogeneous for $A = 23–33Å^2$, heterogeneous for $A = 38–41Å^2$. Considerable difficulty was caused by the different solubilities of crystalline myristic acid and of films thereof in various states and stages of compression. The change from the liquid expanded to the liquid condensed state is attributed to the gradual squeezing out of water from between the chains followed by gradual orientation of the molecules, with probably still further squeezing out of water which affects the dielectric constant and the phase boundary potential. The process is akin to the formation of liquid crystals. [See Abstract 496 (1933).] C. A. S.

See also Abstract 4252.

TIME (STANDARDS, MEASUREMENTS, APPARATUS).

4071. Influence of Magnetic Fields on Watches. A. Jaquerod and H. Mügeli. *Soc. Suisse de Chronométrie, Bull. ann. pp.* 52–74, 1933. *A.T.M.* 4. T 95–96, *July*, 1934. *Abstract.*—Various standard and special watches were submitted to steady magnetic fields up to 350 gauss, and their rates were observed during and after magnetisation. The results are given in graphical form and demonstrate the great superiority of Straumann's non-magnetic watches in which beryllium alloys are used for the balance wheel and staff. P. H. B.

4072. Simple Laboratory Chronograph. C. Weyl, F. M. McPhedran and S. R. Warren. *Radiology*, 23. *pp.* 102–104, *July*, 1934.—For electrical engineering purposes it became necessary to design an apparatus accurately to measure 0·001 sec., between the beginning of a pulse of air and an X-ray exposure, made by a mechanical-electrical

system operated by the air pulse. It is believed this chronograph may have other fields of applications and the construction is therefore described and illustrated. Essentially the instrument consists of a drum, upon which is mounted a 10 in. strip of standard motion picture film, with a device to rotate this drum at a constant speed of 1 r.p.s., with exposure of a part of the film through a small aperture to a light source. Upon the same film X-ray impulses from the X-ray tube are also recorded.
B. J. L.

4073. Precision Relay. H. Martin. *Phys. Zeits.* 35. *pp.* 658–661, *Aug.* 15, 1934.—Describes the adaptation of a "Blue Spot" loud-speaker unit as a precision relay. The behaviour is studied with the aid of a second loud-speaker, fitted as an "optical telephone," connected in series with the relay contacts and a battery. Photographs illustrating the behaviour with d.c. and 60-cycle a.c. are given. Comparisons with pendulum contacts are described, and in favourable circumstances the time-lag of the new relay may be as low as $0{\cdot}000018 \pm 15 \times 10^{-6}$ sec. The author concludes that the new relay can be used to determine the time of an event to an accuracy of 10^{-5} sec. N. F. A.

VISCOSITY, FRICTION AND LUBRICATION.

4074. Comparison of Liquid Viscosity Data. Mary D. Waller. *Phil. Mag.* 18. *pp.* 505–516, *Sept.*, 1934.—For the study of liquid viscosity data it is convenient to take the freezing points t_f and the boiling points t_b of the materials as corresponding temperatures. If the viscosities are then plotted on a graph whose abscissæ are fractions of the interval t_b-t_f, comparisons are simplified. Thus a liquid whose viscosity graph is always above that of another may be said to have a higher intrinsic viscosity; although on a graph drawn to a Centigrade temperature scale, the curves may cross. Liquids can be classified according to the variation of their viscosity between t_f and t_b, in such a way that light is thrown on their molecular symmetry. J. P. A.

4075. Viscosity of Solutions of Strong Electrolytes. V. D. Laurence and J. H. Wolfenden. *Chem. Soc., J. pp.* 1144–1147, *Aug.*, 1934.—The relative viscosity of aqueous solutions of lithium chloride, bromide, iodide, iodate, acetate, and picrate, potassium iodide, iodate, and acetate, acetic acid, tetraethylammonium bromide and picrate has been measured at 25°. The A and B coefficients of the Jones-Dole equation have been calculated. The A values are in good agreement with the Falkenhagen-Dole-Vernon equation. The B values for the inorganic slats show that the additivity of B coefficients for individual ions is probably no more than a satisfactory first approximation. The principle of the additivity of B breaks down unmistakably for the salts containing the tetraethylammonium and the picrate ion, perhaps owing to ion-pair formation. Comparison of the values of B for the acetate ion and the acetic acid molecule shows that the effect of an electric charge is to increase the value of B considerably. AUTHORS.

4076. Viscosity of Undercooled Liquid Glucose. G. S. Parks, L. E. Barton, M. E. Spaght and J. W. Richardson. *Physics,* 5. *pp.* 193–199, *Aug.*, 1934.—The viscosities of undercooled liquid glucose have been extensively studied by three very different methods. Between 145° and 80° about eighty determinations have been made by the falling sphere method; between 80° and 32° seventy-five determinations have been carried out by a concentric cylinder method; and between 34° and 22° thirty samples have been measured by a cylinder torsion method. A series of "best values," ranging from 5·6 poises at 145° to $9 \cdot 1(10)^{13}$ poises at 22° C., have been tabulated from these results. They represent "true" viscosities and not plasticities. That the viscosities of the glucose depend very much upon the history of the sample and its mode of preparation has been shown by several experiments. From a consideration of the variation of the viscosity with the reciprocal of the absolute temperature some "disorientation" energy values have been derived. These are much larger than the formal heat of fusion of glucose and indicate considerable association. AUTHORS.

4077. Alternating Stress Method for the Measurement of the Consistency of Very Stiff Materials. E. C. Bingham and R. A. Stephens. *Physics*, 5. *pp.* 217–220, *Aug.*, 1934.—Samples of rosin, abietic acid and pitch may be made to flow at temperatures as low as 20° C. at low pressures and conveniently short periods of time, sufficient for fluidity determinations. Such a method as this one was devised in the hope of finding a much better control instrument for such materials. No evidence of plasticity was observed. The fluidity was found to be independent of the dimensions of the apparatus used. In the pressure range from 130 to 1800 gm./cm.^{2} no effect of change of pressure upon the fluidity was detected. A study of the effect of changes in pressure upon the flow of plastic materials is now being made. AUTHORS.

4078. Relation Between Ionic Mobility and Viscosity of Medium. Gösta Angel. *Zeits. f. phys. Chem.* 170. *Abt.A.* 1–2. *pp.* 81–96, 1934.—The relationship between ionic mobility and the fluidity of the medium are investigated for cases which deviated from Stokes' Law. It is shown that the Johnston equation $l_t = k\phi^m$ is in agreement with the measurements made by Kohlrausch. H^+ and OH^- ions, acids and bases are no exception to this rule. It is concluded that the equation of Johnston is capable of wide general application. F. J. B.

See also Abstracts 4038, 4069, 4146, 4253.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

4079. Test Bench for the Double Telescope of the Ottica National Institute. R. Bruscaglioni. *Zeits. f. Instrumentenk,* 54. *pp.* 264–271, *Aug.,* 1934.—Reference is made to a method suggested by V. Ronchi for these tests and the present apparatus was devised to reduce the time and cost of the procedure. The following tests are described, (1) parallelism of the axes, (2) sub-division of the dioptric scale, (3) position and size of the emerging beam, (4) scale for the size of the beam, (5) magnification, registration, micrometer value, and position of the cross wires, (6) field of view, (7) parallelism of the image and object, (8) resolving power, (9) astigmatism and curvature of the image, (10) chromatic aberration, (11) deficiencies of performance, eccentricity of eyepiece, spherical aberration, coma, (12) errors of colour magnification, (13) outer-axial emerging beam, and (14) axial and outer-axial photometric efficiency. These tests can be applied during construction and 8–9 hours are required for them all, and less for a series of telescopes. R. S. R.

4080. Photometric Scale for Focal Stellar Images. V. Fesenkov. (Fessenkoff). *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 3. *pp.* 86–87, *July* 11, 1934. *In French.*—The photometric scale of an astronomical plate is a function of the position of the plate relative to the focus; in wide-angle lenses the apparently best image may correspond to a sensibly extra-focal position; and the author has discussed the problem of the position for which the maximum radiation is concentrated on minimum area. The present note gives the results of experiments with artificial stars; showing that displacements from the optimum position towards the objective have negligible effects on the magnitude scale apart from zero point, whereas displacements outwards shorten the scale appreciably. The theoretical discussion is to be published elsewhere.
T. L. M.

4081. Photographic Plates for Use in Astronomy. C. E. K. Mees. *Phot. J.* 74. *pp.* 448–461, *Sept.,* 1934.—Discusses the qualities necessary in photographic plates to be used in astronomy and makes suggestions based on this discussion. A. H.

COMETS AND METEORS.

4082. Air Waves Caused by the Fall of the Great Siberian Meteorite. I. S. Astapowitsch. *Roy. Meteorolog. Soc., J.* 60. *pp.* 493–504, *Oct.,* 1934.—The writer gives a short review of the investigation of the fall of the meteorite in Central Siberia on 30th June, 1908, and gives the results of the barograph records obtained by him at the time of his research expeditions of 1930 to 1932. The time of fall of the meteorite and the force of the explosion were determined by examination of various independent sources. The air wave must have been recorded by microbarograms in Japan, China, India and perhaps America. AUTHOR.

4083. Phenomena Related to the Great Siberian Meteor. F. J. W. Whipple. *Roy. Meteorolog. Soc., J.* 60. *pp.* 505–512; *Disc.,* 512–513, *Oct.,* 1934.—This paper is supplementary to one previously published by the author [see Abstract 3665 (1930)]. Additional evidence with regard to the illumination of the sky during the nights following the arrival of the meteor is summarised. In view of the fact that recorded observations of this phenomenon are confined to the north of Europe, it is suggested that the meteor had a tail which was to be captured by the earth's atmosphere. The air waves produced by the meteor were recorded at Batavia and at Washington as well as at several places in Europe; the records are discussed and the velocities of propagation of waves travelling in different directions are compared. AUTHOR.

COSMOGONY.

4084. Kant and Law of Areas. R. Emden. *Naturwiss.* 22. *pp.* 533–535, *Aug.* 10, 1934.—A defence of Kant's ideas regarding the structure of the universe and the principle of angular momentum. G. C. McV.

See also Abstracts **4085, 4086.**

DYNAMICAL PROBLEMS (ASTRONOMICAL).

See Abstract **4049.**

NEBULÆ.

4085. Selective Absorption in Interstellar Space. W. Becker. *Naturwiss.* 35. *pp.* 581–588, *Aug.* 31, 1934.—The author collects the results of recent work, showing the importance and amount of interstellar absorption. The dependence of colour excess on distance, galactic latitude and longitude is illustrated. Evidence for the existence of dust clouds is collected and the independence of this form of absorption from interstellar Ca is discussed. T. L. M.

See also Abstract **4195.**

PLANETS.

4086. Ozone and Oxygen in Planetary Atmospheres. R. Wildt. *Göttingen Nachrichten* 1. 1 *Fachgruppe* 2. *pp.* 1–9, 1934.—The author criticises Eropkin's conclusions [see Abstract 520 (1934)] on theoretical and observational grounds. In order to test the presence of extensive ozone layers in the outer planets, the ultra-violet spectrum of Uranus is compared with stars and hence indirectly with the sun. The characteristics of the relative intensity curves are accounted for. There is only feeble evidence of the ultra-violet ozone bands, implying less than 0·5 cm. equivalent ozone layer in Uranus. Doubt is therefore thrown on Eropkin's identification of the visual (Chappuis) bands. The absence of oxygen from the observed spectrum of Venus and the small proportion on Mars also suggest that the atmospheres of the different planets present great differences. Most of the terrestrial oxygen may be due to assimilation of CO_2 by vegetable life; the author suggests that a high surface temperature on Venus has prevented this process, leading to an atmosphere of volcanic CO_2 and lack of free oxygen. For Mars the free oxygen has largely entered into mineral oxides, such as Fe_2O_3, producing the red coloration; the ozone layer is possibly close to the surface, and would then play a very different part from that of the earth's ozone. T. L. M.

STARS.

4087. Systematic Errors in Trigonometrical Parallaxes. C. Davidson. *Observatory,* 57. *pp.* 236–238, *Aug.*, 1934.—A critique of A. van Maanen's empirical corrections in terms of right ascension. Several causes of error are reviewed and a possible explanation of a seasonal correction suggested. [See Abstract 5206 (1933).] T. L. M.

4088. Perturbed Motion of Stellar Systems. V. Nobile. *Accad. Lincei, Atti.* 19. *pp.* 682–688, *May* 20, 1934.—In a paper of 1926 (*Mem. della Soc. Astronom. Italiana, III, p.* 4) the author showed that it was possible by utilising the spectrographic determinations of the radial components of the velocity in the relative orbital motion in a binary stellar system, and by confining with these measurements the ordinary measurements of position, to arrive at a direct verification of the first of Kepler's laws, unattainable by the ordinary measurements of distances and angles alone. The laws of gravitation, as deduced from the solar system, were employed, with the advantage of simplicity and of the absence of hypotheses. Spectrographic observations can render similar aid in the study of systems consisting of three stars of which one is dark. The observed perturbations of the motion are attributed to the presence of the dark star. The author works out the theory of this mathematically, and promises an investigation into another aspect of the problem. A. D.

4089. Orbit of Boss 35 BR. Elizabeth MacCormack. *Mt. Wilson Observat., Contrib. No.* 495. *Astrophys. J.* 80. *pp.* 120–123, *Sept.*, 1934.—A determination of the orbit of the brighter component of Boss 35 from fifty-five spectrograms obtained at the Mount Wilson Observatory. AUTHOR.

4090. Spectrum of α Canis Minoris (Procyon) (Class d F5). S. Albrecht. *Astrophys. J.* 80. *pp.* 86–119, *Sept.*, 1934.—The present paper on the standard velocity star Procyon is the second of a series covering classes Ao-Mb. Only laboratory wave-lengths produced under known and controlled conditions are employed, so that the results are free from spurious systematic effects, and they are practically free from errors due to uncertainties in adopted normals. Owing to the fundamental character of the reductions, the radial velocities derived for this standard velocity star will (except for certain reservations) qualify as standard radial velocities. The author throws grave doubt on the reality of a statement, made in 1933, that Procyon is a spectroscopic (as well as a visual) binary with a period of the order of one-fourth of a day, inasmuch as one of the 7 3-prism spectrograms employed, underwent a change of temperature of 0°·9 C. in the course of its exposure. There are 4 tables ; the 4th gives for 1094 lines (measured on the 7 three-prism spectrograms), the observed wave-length to 0·001 I.A., p.e., estimated intensity, measured width, number of plates on which measured, and identification with laboratory and solar lines. A. S. D. M.

See also Abstracts 4080, 4085, 4195.

SUN.

4091. Observing Solar Corona without Eclipse. A. M. Skellett. *Nat. Acad. Sci., Proc.* 20. *pp.* 461–464, *Aug.*, 1934.—The author suggests a modification of the mechanism of television: the images of the sky around the sun being scanned by a small opening behind which is a photoelectric cell. The appropriate component of the photoelectric current is selected by electrical filters. Laboratory tests indicate that the method would be sufficiently delicate to discriminate the corona from atmospheric glare, but an observatory trial is desirable. T. L. M.

4092. Zeeman Effect in the Sunspot Spectrum. R. B. King. *Mt. Wilson Observat., Contrib. No.* 497. *Astrophys. J.* 80. *pp.* 136–153, *Sept.*, 1934.—This is the first extensive study made of the Zeeman effect in spot spectra since Hale's discovery and investigation of magnetic fields in sunspots, and much new material is now available, both theoretical and observational. A blending effect is found, probably due to the inclination of lines of force in the spot to the line of sight, which tends to reduce the apparent field-strength: 416 lines therefore were selected for measurement in which this effect should be much diminished. It is confirmed that the behaviour of sunspot lines appears to be intimately connected with intensity, that is with level. Strong lines in general show a small magnetic effect, small Evershed effect, and small strengthening, while weak lines in general show larger values of all these features. Evershed effects are more closely correlated with disc intensities, field-strengths with spot intensities. No relation has been found between field-strength and the strengthening of faint spot lines in multiplets. New observations made under controlled conditions and with a larger number of spots are necessary for more definite quantitative results. M. A. E.

4093. Horizontal Diameter of Sun. A. di Legge. *Accad. Lincei, Atti*, 19. *pp*. 676–681, *May* 20, 1934.—Tabulated data. The mean annual value of the horizontal semi-diameter of the sun as deduced by the author and his school from 21774 observations extending over 37 years is 961″·18. This agrees exactly with the datum given by Auwers, but differs slightly from the value used in the calculation of eclipses. A. D.

4094. Temperature Classification of Infra-Red Iron Lines. A. S. King. *Mt. Wilson Observat., Contrib. No.* 496. *Astrophys. J.* 80. *pp*. 124–135, *Sept*., 1934.—The spectrum of iron from λ 6400 to λ 10500 has been observed at various temperatures in the electric furnace as well as in the arc. Temperature classification is given for 367 lines, based as far as possible on intensity variation at different furnace temperatures, but also on the widening phenomena of the high-current arc, which indicates the degree of excitation required for lines that do not appear in the furnace spectrum. Prominent line groups belonging to various temperature classes are discussed. Seventeen iron lines which had been predicted from multiplet structures and which are present in the solar spectrum were identified on arc spectrograms. Twenty-two infra-red solar lines, previously unidentified or of uncertain origin, were found in the present study to be due to iron. A comparison with the incomplete data available in the infra-red for the sunspot spectrum shows a distinct tendency of low-temperature lines to strengthen in sunspots and of high-temperature lines to weaken, in agreement with the condition previously found to hold in the visible spectrum. AUTHOR.

See also Abstract 4128.

ZODIACAL LIGHT AND GEGENSCHEIN.

See Abstract 4128.

GEOPHYSICS.

GEOPHYSICS, APPLIED.

4095. Normal Distribution of the Planes of Electromagnetic Polarisation in an Electrified Subsoil. A. Belluigi. *Beitr. z. angew. Geophys.* 4. 4. *pp.* 395–399, 1934.—The vectorial expressions are given for a linear, a circular, and an elliptical polarised electromagnetic field, and an investigation is made of the distribution of the sections of the planes of polarisation with the horizontal plane for the case of a homogeneous and isotropic subsoil. This distribution allows in some cases the comparison with other already studied and partly simplified cases. The author comments on the advantage of taking into account this normal distribution. J. J. S.

4096. Effect of Anisotropy in D.C. Measurements. A. Belluigi. *Beitr. z. angew. Geophys.* 4. 4. *pp.* 400–406, 1934.—The author has previously discussed in a paper on d.c. measurements the method of Wenner and methods therefrom deduced, and dealt chiefly with the advantage of the apparatus with doubled compensation, in which the natural polarisation and tension at the measuring probes are compensated. A test of utility is that always the same specific apparent resistance is obtained (1) with change of the current flowing through the earth, (2) with various distances of the probes in the homogeneous medium. The work of various investigators is commented upon, and the effect of anisotropy is dealt with. In carrying out the electrical measurements the correction for anisotropy can in practice be neglected. J. J. S.

4097. Detection of Caverns in Karst Formation by Radiation-Absorption Method. V. Fritsch. *Beitr. z. angew. Geophys.* 4. 4. *pp.* 416–425, 1934.–Electromagnetic radiation of frequency $\nu = (\omega/2\pi)$ and wave-length λ was produced at a series of points, A, and its intensity determined at another series, B, pairs of points AB being on opposite sides of a ridge. If κ and ϵ are respectively the conductivity and dielectric constant of the material of the ridge, R the portion of the distance AB apparently within such material, E_0, E the electric field strengths at points A and B, $E = E_0 e^{-\gamma R}$, where $\gamma^2 = 2\pi(\sqrt{\kappa^2 + \epsilon^2\omega^2} - \epsilon\omega)/\lambda^2\omega$. By comparing the observed and calculated values of E, and considering the probable nature of the material traversed by AB, the structure of the ridge, existence of caverns, etc., can be inferred. The method is exemplified by tracing the underground course of the river Punkwa (12 m. north of Brunn, Moravia) and demonstrating the existence of caverns thereon. C. A. S.

4098. Phases on Explosion Records in a 3-Layered Region. L. D. Leet. *Gerlands Beitr. z. Geophys.* 42. 2–3. *pp.* 246–251, 1934. *In English.*—Describes surface-reflected phases observed on the records of reversed seismic surveying profiles 12 km. in length. AUTHOR.

See also Abstract 4103.

HYDROSPHERE, PHYSICS OF THE.

4099. Application of Fredholm's Integral Equations to the Numerical Computation of Drift Currents. K. Hidaka. *Geophys. Mag., Tokyo,* 8. *pp.* 103–113, *July,* 1934. *In English.*—Formerly the numerical computation of ocean currents given by theoretical investigations has been by means of explicit formulæ for the velocity components which are obtained by solving directly the differential equations of hydrodynamics. In the present paper a method is given for calculating the steady ocean currents from integral equations which do not involve the velocity components directly, and it is especially useful when the coefficient of virtual friction is an arbitrary function of depth. The method was applied to the drift current observations made by Sverdrup on the N. Siberian shelf and values for different depths are tabulated and shown graphically. R. S. R.

4100. Convection Current of Ekman's Type in a Given Solenoidal Field. K. Hidaka. *Geophys. Mag., Tokyo,* 8. *pp.* 115–120, *July,* 1934. *In English.*—Reference is made to results obtained by Ekman and Nomitsu in mathematical investigations of the convection current for various types of solenoidal fields. In this paper the horizontal pressure gradients and the coefficient of eddy viscosity are treated as given functions of the depth. Solutions are obtained with the help of Fredholm's integral equations of the second type and the explicit form of the convection current is obtained in Neumann's and Schmidt's formulæ. The problem can be solved numerically when the vertical distribution of the horizontal pressure gradients and of the coefficient of virtual friction are given in advance. A convenient method for numerical computation is given. R. S. R.

LAND, PHYSICS OF THE.

4101. Earth Contraction and Mountain Building. E. M. Anderson. *Gerlands Beitr. z. Geophys.* 42. 2–3. *pp.* 133–159, 1934. *In English.*—The surface flow of heat at present is probably less than has been assumed by some recent writers. The actual value may not be far from $1\cdot633 \times 10^{-6}$ cal. sec.$^{-1}$ cm.$^{-2}$, the British Association figure. If it had not been for the recent glaciation the amount would have been larger, but probably not more than about 2×10^{-6} cal. sec.$^{-1}$ cm.$^{-2}$. The low value is in favour of low crustal temperatures, such as are assumed by supporters of the contraction theory, but other considerations are against this. Reasons may be given for presuming that the "granitic layer" of the earth's crust has somewhat the same composition as the Scottish Lewisian Gneiss. It must in that case have a lower radioactive content than normal granite. The sedimentary layer which overlies it is in places at least 6 km. in thickness, and this layer is also poor in radioactive constituents. By an apparent paradox, these facts make it possible to deduce higher temperatures for the deeper Continental layers. AUTHOR.

4102. Penetrating Radiation from the Earth's Crust. L. Bogojavlensky. *Beitr. z. angew. Geophys.* 4. 4. *pp.* 437–451, 1934. *In French.*—A connected account is given of ten years' researches regarding the penetrating radiation from the earth at various places in Russia and Siberia. The electrometer used has brass walls 15 mm. thick, covered thinly with tin, and could be surrounded with lead up to 8 cm. thick. Ionisation due to radiation from the walls, defective insulation, and cosmic radiation being constant, variations measured were due to changes in terrestrial radiation. This is independent of meteorological conditions and constant at any one place, but varies considerably from place to place with the geological structure. It is also very complex. Intensity of radiation and consequently of ionisation is always more intense at places frequently struck by lightning [see Abstract 3178 (1931)]. In any one locality the curve showing intensity of radiation is similar to that electrically determined, showing the depth of a layer of rock of higher electric resistance, which therefore is probably the source of the radiation. The mean coefficient of absorption is $1 \cdot 80 \times 10^{-4}$ cm.$^{-1}$, the absorbing material at the locality concerned being probably $CaCO_3$. This by the Klein-Nishina formula, gives a wave-length of $1 \cdot 92 \times 10^{-6}$ Å, a frequency of $1 \cdot 56 \times 10^{24}$, and energy of 650×10^{6} e.V. C. A. S.

4103. Electrical Measurements on Soil with A.C. R. L. Smith-Rose. *I.E.E., J.* 75. *pp.* 221–237, *Aug.*, 1934.—A summary of previous measurements of the dielectric properties of soil is given. Then, using a method already described [see Abstract 3434 (1933)], results are given of measurements made on samples taken at depths up to 300 ft. from a number of sites in Great Britain. The frequency range is from $10^6 \sim$ to $50 \sim$. The variation of dielectric constant and conductivity with moisture content, frequency and temperature are given, as well as the differences due to depth of type of soil. The values obtained are used to find the distribution of h.f. currents below the surface at five sites. The effect of such current penetration on a field at the surface is to be dealt with later. W. H. W.

See also Abstract 4045.

METEOROLOGY.

4104. Heat Content of the Atmosphere of the Northern Hemisphere. Part I. Radiation with Normal Solar Constant. F. Baur and H. Philipps. *Gerlands Beitr. z. Geophys.* 42. 2–3. *pp.* 160–207, 1934. —Formulæ are given for calculating the quantity of heat coming from the sun for use with or without an atmosphere. The formulæ were applied for each 10° zone of the northern hemisphere from 0° to 90° for 5-day periods in January and July, and at the equinoxes and solstices to obtain (*a*) the quantities of heat supplied by the sun (1) to the upper limit of the atmosphere; (2) to the surface of the earth neglecting turbidity and cloudiness; and (3) to the surface of the earth, allowing for the daily turbidity and cloudiness; (*b*) the quantities of heat absorbed by water vapour and clouds in the atmosphere; and (*c*) the quantities of heat supplied directly and indirectly to the earth's surface considering turbidity and cloudiness. The calculations are based on a normal value for the solar constant of $1 \cdot 940$ cal. cm.$^{-2}$ min.$^{-1}$. From the gain and loss of heat the meridional heat transport can be calculated. Later the gain and loss of heat with smaller and greater solar constants are to be calculated to find the influence of the solar constant on the heat interchange between lower and higher latitudes of the earth. R. S. R.

4105. Long-Wave Sky and Earth Radiation. E. Hasché. *Gerlands Beitr. z. Geophys.* 42. 2–3. *pp.* 228–231, 1934.—Mean hourly values of the specific radiation intensity are tabulated for seven different days. The effect of short-wave radiation has been subtracted. The accuracy of measurements on cloudless days and nights are ± 8 % and ± 6 % respectively and on most favourable nights ± 3 %. Emission has the same characteristic curve on all cloudless days. Long-wave radiation increases after sunrise to a maximum at sunset, followed by a steep fall and then a slow decrease during the night. With overcast skies long-wave emission from the sky is seldom registered and only that from the earth remains. The yearly changes of emission run parallel to that for short-wave absorption. R. S. R.

4106. Effect of a Forest on the Temperature of the Air. P. Seltzer. *Comptes Rendus,* 199. *pp.* 435–438, *Aug.* 6, 1934.—Temperature observations were made at Haguenau in a clump of young oaks at five different levels ranging from 1 m. 45 cm. to 11 m. 90 cm. above the ground, the last two levels being above the tree tops. These observations show that in May–June, 1934, the hour of maximum becomes later with increasing height above the ground, and that the highest value occurs at the tree tops. Observations in April show that even when leaves are not yet present, the warm air has not penetrated to the interior of the forest. The opposite effect was observed in June, when in spite of the foliage the cold air sinks down into the forest. So the author concludes that the branches even when free of leaves cause a sharp separation between masses of air above and below them if the air is divided in layers of decreasing density from the ground upwards, but in the opposite case the effect is nil. A. E. M. G.

4107. Splashing of Rain. S. E. Ashmore. *Roy. Meteorolog. Soc., J.* 60. *pp.* 517–522, *Oct.,* 1934.—The connection between the rate of rainfall and the splashing produced by it from a horizontal surface has been studied experimentally for a large number of surfaces which may be used as the surroundings for rain-gauges. The splashing from ice and water has also been investigated. The results may be utilised (1) in forming an estimate of the number of occasions on which the rainfall recorded by a standard gauge is too large on account of insplashing; (2) in deciding on the best material on which to set up a rain-gauge or sink an evaporation tank. Suggestions are given on how to eliminate the effects of outsplashing from evaporimeters. AUTHOR.

4108. Cartographic Study of Drought. W. R. Baldwin-Wiseman. *Roy. Meteorolog. Soc., J.* 60. *pp.* 523–532, *Oct.,* 1934.—The drought under review occurred in Queensland in 1902. Records from long periods are necessary for a proper application of this method but if these be not available a reasonable approximation can be obtained with shorter records. This applies in the case of several of the Queensland records. Lines called isodefs or lines of equal percentages deficiency from the mean are drawn, for each of the twelve months of the year. The distribution of these lines and their movements from one month to another are discussed. This enables the determination of the drought track to be made. Certain areas are comparatively free from the drought effects. The author points out that such studies will in time afford sufficient reliable data on which to base insurance schemes against loss of crops and stocks. A. E. M. G.

4109. Post-Glacial Climates and the Forests of Europe. C. E. P. Brooks. *Roy. Meteorolog. Soc., J.* 60. *pp.* 377–395, *Oct.,* 1934.—The Blytt-Sernander succession of post-glacial climates is first examined giving (1) boreal, 6800–5000 B.C., (2) Atlantic 5000–3000 B.C., (3) sub-boreal 3000–850 B.C., and (4) sub-Atlantic 850 B.C. to present time. The evidence used in discussing the succession includes (1) the various types of peat deposits, (2) variation of lake levels, (3) study of pollen frequency with the climatic requirements of tree types and their distribution in Europe, and (4) investigation of fossil snails. A summary is given of the climatic features of these periods (1) pre-boreal—very cold winters, cool summers, dry; (2) boreal—cold winters, hot summers, dry especially in summer; (3) Atlantic—mild rainy winters, summers hot and fairly moist but with frequent summer droughts; (4) sub-boreal—winters rather mild, summers hot, rainfall doubtful, probably fluctuating; (5) sub-Atlantic—winters moderate, summers cool, wet; and (6) present—probably tending in the direction of greater dryness and perhaps also of lower temperature. Finally the cosmical and geographical factors operating in post-glacial times to effect changes of climate are considered. R. S. R.

4110. Energy in Climatology. Heat Balance in the Atmosphere. F. Möller. *Gerlands Beitr. z. Geophys.* 42. 2–3. *pp.* 252–278, 1934.—The author seeks to obtain the energy balance in the atmosphere by consideration of the various processes which may give rise to temperature changes and from the changes of temperature with time conclusions are drawn regarding the energy balance. The absorption and emission of radiation by the earth and the atmosphere are most important and the rôle of vaporisation and condensation of water vapour and of heat conduction at the surface is a minor one. The importance of advective processes is stressed and the varying effect of this factor in Europe, at the centre and edges of large continental and sea masses, and in the tropics and polar regions is discussed. R. S. R.

4111. Polarisation of Light from the Sky. F. Blickhan. *Gerlands Beitr. z. Geophys.* 42. 2–3. *pp.* 208–227, 1934.—The author has dealt with a series of simultaneous measurements at Frankfurt and Taunus of the polarisation (P) when at its daily maximum for the years 1925–7 and 1931–3. These values were connected with simultaneous values of turbidity (T). It was found that in a large town P is a minimum before, and in the mountains after, the sun is at the zenith. The yearly maximum occurs in spring but the minimum is in autumn and winter at Frankfurt and in summer at the Taunus. P had its maximum value in polar air and its minimum in maritime air. Empirical relations between P, T and the solar altitude are set up. It is found that for light reflected by dust and smoke particles scarcely more than 0·050 is polarised. By extrapolation to a pure atmosphere good agreement with Dorno's results is obtained. Assuming secondary scattering in the atmosphere, Milch's depolarisation factor can be applied and with the help of Ahlgrimm's theory the change of polarisation with solar altitude with approximately constant turbidity can be obtained. R. S. R.

4112. Light from the Night Sky. J. V. Karandikar. *Indian Journ. Phys.* 8. 6. *pp.* 547–554, *June*, 1934.—Previous observations on the night sky gave different results for the variation of light intensity according to latitude. The present set carried out at Poona because of its freedom from cloud for nearly 6 months of the year, shows that for the green light the general tendency is for the intensity to decrease after sunset, reach a minimum between midnight and 2 hours and then to increase again. The intensities at equal intervals before and after the minimum are unequal, being greater before. Starlight does not vitiate the general results. Variations of other radiations are similar to those of the green radiation. A description is given of the methods of observation adopted and the plates and filters used. A. E. M. G.

4113. Auroræ at Scoresby Sound During the Polar Year. A. Dauvillier. *J. de Physique et le Radium*, 5. *pp.* 398–412, *Aug.*, 1934.—A more detailed account is given of the observations of the auroræ, the methods of making them, and the deductions therefrom. In particular a photoelectric method is described for measuring their intensity, and one by which auroræ invisible to the eye can be detected and measured. [See Abstract 3229 (1934).] C. A. S.

4114. Recent Advances in Anemometry. C. F. Marvin. *Monthly Weather Rev.* 62. *pp.* 115–120, *April*, 1934.—The author has advocated certain simple and exact methods of testing rotation anemometers. The effects of friction especially at low velocities are discussed and the prerequisites in design to reduce friction are laid down. Equations and curves are given which connect the true wind velocity and the number of cup turns per mile. The effects of small scale turbulence on the cup speeds are considered and of a strengthened beaded edge to the cup for use in high winds. Finally a summary is given of the results of tests on various types of anemometers, the percentage relationships which have been obtained regarding turbulence, and the form of the cups. R. S. R.

4115. Wind Direction and Wind Speed Indicator for Yacht "Endeavour." D. C. Gall. *Journ. Sci. Instruments,* 11. *pp.* 279–280, *Sept.,* 1934.—An electrical device for repeating the indications of the wind vane on the masthead of the yacht at a position near the binnacle is described. The slider of a specially designed circular rheostat is coupled to the vane and is connected in a potentiometer circuit; its position is thus indicated on a voltmeter with a 360° scale. The wind speed is indicated by an anemometer of the hot-wire type. AUTHOR.

4116. Natural History of Weather. N. Shaw. *Roy. Meteorolog. Soc., J.* 60. *pp.* 479–489; *Disc.,* 489–492, *Oct.,* 1934.—The author after referring to results of the work of the local meteorologist, and the uses to which these are put at present, suggests a new method of application of meteorological observations. The coordination of observations in a way suited to the requirements of such arts and sciences as agriculture, ecology, etc. is discussed. In place of the usual calendar months, the year is divided into twelve "chapters," four of these of five weeks each are centred on the solstices and equinoxes, the others consist of four weeks each. This method enables the comparison of the effects of the "long days" and the "short days." The information obtained by observation is rendered available at any time for each of the elements and for each week of year by arranging it in tabular form, each column of the figure corresponding to one "chapter" with its four or five weeks or "verses." The meteorological events of any week can thus be recalled and placed alongside other natural phenomena recorded in the same week. Such methods will help to widen the meteorological horizon. In the *Discussion* the closer study of the reaction of crop plants to climate is urged by the method suggested by the author. Other points considered are the unit of time used, and the time of commencement of the year. In the paper November 6 is adopted for the latter. A. E. M. G.

See also Abstracts 4086, 4125, 4128.

SEISMOLOGY.

4117. Propagation of Tremors over the Plane Surface of an Elastic Solid. T. Sakai. *Geophys. Mag., Tokyo,* 8. *pp.* 1–71, *July,* 1934. *In English.*—Propagation of tremors from three species of internal source is considered: (1) a dilatational point source, giving results already stated [see Abstract 4829 (1933)], where the symbols here used are explained; and distortional sources in which the displacement is (2) parallel, and (3) perpendicular to the plane surface. With (2) equivoluminal (*S*) waves alone appear at points near the epicentre, but are accompanied by irrotational (*P*) and Rayleigh waves when r is $> v_2 d\sqrt{v_1^2 - v_2^2}$ and $v_3 d\sqrt{v_1^2 - v_3^2}$ respectively. The amplitudes of the *S*, *P*, and Rayleigh waves are proportional respectively to $1/r^2$, $1/r^3$ and $1/\sqrt{r}$. With (3) only *S* waves occur, of amplitude dependent on both $1/R$ and $1/R^2$. The motions of points on the surface due to each kind of wave, and the duration of shocks are calculated. When all three sources are simultaneously active the Rayleigh waves have the greatest amplitude at large epicentral distances, followed by the *S* waves with horizontal displacement. C. A. S.

4118. Propagation of Elastic Waves in Non-Ideally Elastic Media. B. Derjaguin. *Beitr. z. angew. Geophys.* 4. 4. *pp.* 452–469, 1934. *In French.*—Boltzmann's theory of elastic after-effect in a non-ideally elastic medium is shown mathematically to give results in agreement with experiment as regards extinction of vibration of frequencies 0·1–40,000 Hertz. When applied to elastic waves in the earth its deductions agree with seismologically determined results as regards the coefficient of extinction being proportional to their length and independent of frequency provided the waves are not too short; it also accounts for transverse waves being extinguished in one-fourth the distance that longitudinal waves are; for the anomalous dispersion of volume waves; and for the extinction of surface (Rayleigh) waves, provided that the elastic properties of the surface layer are similar to those of glass. C. A. S.

4119. Analysis of New England Microseisms. L. D. Leet. *Gerlands Beitr. z. Geophys.* 42. 2–3. *pp.* 232–245, 1934. *In English.*—The motion of an earth particle in the path of microseisms was analysed from Harvard Seismograph Station records. Longitudinal and transverse waves were identified. No Rayleigh waves were found. Nothing in the analysis shows whether the transverse waves are of surface or body type. Waves from S.E., E., and N.E. have been isolated on the Harvard records. Evidence favours storm waves in large bodies of water as the cause, whether they beat upon rocky coasts or not. Correlations with nine cyclonic storms are listed in detail. AUTHOR.

4120. S_cS Waves of Deep-Focus Earthquakes Observed near the Epicentre. K. Kadoya and S. Hidaka. *Geophys. Mag., Tokyo,* 8. *pp.* 73–76, *July,* 1934. *In English.*—Travel-time curves for the S_cS wave have been calculated on a basis of (1) Gutenburg's, and (2) Wadati and Oki's values for the velocity of the *S* wave, and the times so determined compared with observation in earthquakes for which $\Delta = 630-1500$ km. and focal depth 300–400 km. Times based on (1) show an average difference from observation of 8·1 %, those on (2) of 2·3 %. C. A. S.

4121. S_cS Waves of Deep-Focus Earthquakes Observed near the Epicentre, and their Applications. M. Miyamoto. *Geophys. Mag., Tokyo,* 8. *pp.* 77–101, *July,* 1934. *In English.*—The data regarding 22 deep (130–660 km.) and two shallow (45–47 km.) focus earthquakes are examined. It is shown that the focal depths deduced from the arrival times at stations near the epicentre ($\Delta \ngtr 32\cdot2^\circ$) of the S_cS wave (which is usually well defined) agree well with those otherwise determined. In seismograms of deep-focus earthquakes there is often observed some 4–6 secs. before the sharp beginning (*iS*) of the *S* phase a less well defined phase (*eS*); confusion as to which is to be regarded as the true beginning of the *S* phase appears to account for the difference between the ratios of the velocities of the *P* and *S* waves as stated by various observers, V_P/V_S based on *eS* being 1·72, on *iS* 1·79. In the upper part of the ultrabasic layer the velocity of the *P* wave is 7·65 km./sec. The depth of the earth core below Japan is confirmed as 2900 km. C. A. S.

4122. Proper Periods of Vibration of the Subsoil: their Excitation and Seismic Bearing. R. Köhler. *Göttingen Nachrichten,* 1. 2. *Fachgruppe* 2. *pp.* 11–42, 1934.—The existence of a proper period of vibration of the subsoil is demonstrated by examination of seismograms recorded at three stations at Göttingen at varying distances from a machine causing periodic vibrations. The predominant period is 0·3–0·4 sec., attributed to an upper layer about 2 km. thick. A weaker vibration of period 1·2 sec. is shown at the most distant station, this is either the fundamental period of that of 0·3–0·4 sec., or the proper period of a thicker layer. These results are confirmed by the prevalence of vibrations of the shorter period in seismograms of earthquakes of foci distant $\ngtr$ 300 km., some vibrations due to which synchronise sufficiently closely with those of the soil to cause resonance. For more distant earthquakes the soil behaves as a homogeneous medium. The importance of such a period as regards destructive action of earthquakes, vibrating engines, and road traffic is emphasised. C. A. S.

4123. Resonance Methods in Seismic Investigations. G. Angenheister. *Union Géodésique et Géophysique, Série A. Travaux Scientifiques, No.* 10. *pp.* 3–11, 1934. *In German.*—The object under examination is thrown into vibration by (*e.g.* a seismograph) being placed on a shaking table, or (*e.g.* a building or soil) the attachment thereto of a flywheel with eccentric mass, the rate of rotation of which is gradually varied within suitable limits. The activating and resultant vibrations are recorded. Applied to a seismograph an unexpected proper period was detected and information obtained regarding magnification and phase retardation. The proper period of a building is usually very much smaller than that of any earthquake vibration, as also is the period of vibrations due to machinery or traffic. Consequently damage may be caused by vibration due to these though intrinsically much weaker than those due to an earthquake which caused little damage. In the case of soil the amplitude varies greatly with its nature, *e.g.*, that caused by the same source was ten times as great in alluvial gravel as in shell limestone. C. A. S.

4124. Seismograph with Horizontal Pendulum. N. Critikos. *Union Géodésique et Géophysique, Série A. Travaux Scientifiques, No.* 10. *pp.* 19–27, 1934.—The instrument is designed for recording violent local movements with, therefore, comparatively small sensitiveness and magnification, but of great strength and simple to manipulate. The pendulum weighs about 40 kg., its period is 2–3 sec., magnification up to 10, and sensitiveness 3 mm. for an inclination of 1 ft., the record is on smoked paper. It is fully described and illustrated. C. A. S.

See also Abstracts **4039**, **4082**, **4083**.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

4125. Lightning and Aircraft. G. C. Simpson. *Meteorolog. Office, Prof. Notes, No.* 66 [24 *pp.*], 1934.—The author considers first the formation of the atmospheric electric field and of charges in clouds. The electric conditions are then considered for (1) clear sky, (2) more or less cloud or fog, but no precipitation, (3) steady light rain, (4) showery rain, especially from detached clouds, (5) heavy showery rain, (6) hail or soft hail, (7) snow, and (8) dust storms. The effects of these conditions on an aeroplane in flight in assisting a discharge already started or shortening the insulating path are discussed with regard to the electric discharge itself and on the component parts of the aircraft and its fittings and the precautions to be adopted to decrease damage. The effects on airships and kite balloons are next considered. Ten cases of aircraft struck by lightning are examined and as an addendum the report of the committee on the protection of airships from danger by lightning discharge is given. R. S. R.

4126. Distribution of Sizes of Atmospheric Ions and Nature of Air Particles. N. Weger. *Gerlands Beitr. z. Geophys.* 42. 2–3. *pp.* 331–350, 1934.—The velocity in free air of atmospheric ions was measured at the Taunus Observatory (Kleiner Feldberg) and the mobility spectrum, thus obtained, was taken as a measure of the size of the ions. A very sensitive electrometer is necessary as the concentration of the ions is small. Tables and graphs are given to show how the sizes of the ions depend upon the weather conditions. Great care is taken to eliminate errors and the experiments are repeated many times under the same conditions to obtain consistent results. H. M. B.

4127. Mean Frequency of Thunder over British Isles and Surrounding Areas. W. A. L. Marshall. *Roy. Meteorolog. Soc., J.* 60. *pp.* 413–422; *Disc.*, 422–424, *Oct.*, 1934.—The mean number of days per month on which thunder was heard is tabulated for 118 stations, based on records extending over $\not<$ 10 years, and the quarterly and annual averages plotted on maps. In general the number is a maximum in July–August, a minimum in Dec.–Feb., it increases from N. to S., and (especially) as the general climate is more "continental." The minimum recorded is for Iceland ($<$ 1 day per annum), the maximum at Bamberg (31·2), Nürnberg (27·4) and Paris (27·2); and for Britain at Bennington (22·6). At Valentia the number for each month (0·4–0·6) varies little throughout the year; winter thunder is specially likely on the north coast of Brittany. C. A. S.

4128. Electromagnetic Phenomena Produced by the Sun on the Earth. A. Dauvillier. *Gerlands Beitr. z. Geophys.* 42. 1. *pp.* 3–11, 1934. *In French.*—A review of observations made at Scoresby Sound during the Polar Year. The phenomena referred to are those caused by electronic radiation from the sun, namely, terrestrial magnetism, earth currents, vertical atmospheric current, cosmic rays, polar and non-polar auroræ and atmospheric ozone. A synthetic interpretation of the phenomena is first put forward; this is followed by notes of some of them. Polar auroræ were observed in the open from mid-September to mid-April in 3-hr. watches during the 17-hr. polar night from a tower in which the observer was in a current of warm air. In bad weather spectroscopic observations were made through double windows. The aurora began on the S.E. horizon over Iceland, passed the zenith half an hour later, and disappeared in the N.W. The direction of the rays was that of the magnetic dip, and the principal maximum occurred at 21½ hr. local time. The curve of diurnal auroral activity agreed with that of magnetic disturbance. The variation was irregular during the last quarter of 1932, but in the first quarter of 1933 its period coincided with that of the rotation of the sun (27 days), but the two curves were opposite in phase to that of the solar activity. There is a considerable accumulation of ozone during the polar night; it is produced by auroral activity, and solar ultra-violet radiation tends to decompose it. Cosmic rays, which are subject to a barometric effect, were found to have an intensity of 2·81 pairs of ions per cm.^{3} per sec. at 0° and 76 cm. The radiation may remain constant for several hours or it may fluctuate irregularly by as much as 17 %. In the explanatory theory given by the author solar electrons are accelerated as they pass through the electric field of the chromosphere. They form the solar corona and the zodiacal light and traverse the earth's upper atmosphere. Secondary electrons are emitted which give rise to auroræ, ozone and earth currents, and photons are emitted which constitute cosmic rays. G. E. A.

See also Abstracts **4103, 4172.**

RADIOACTIVITY.

4129. Mass of the Neutrino. T. Takéuchi. *Phys. Math. Soc. Japan, Proc.* 16. *pp.* 294–295, *Aug.*, 1934. *In French.*—Assuming that the photon is formed by the union of a neutrino and antineutrino, respectively of positive and negative energy and masses m_+ and m_-, the transformation of a neutrino into an antineutrino involving a loss of energy $= 2m_-c^2 (\approx 2m_+c^2$, the radiated energy due to the union), the mass of the photon is $m_+ - m_-$, which is not exactly zero, but, as previously calculated [see Abstract 1829 (1929)], $0{\cdot}4 \times 10^{-63}$ gm. To the neutrino and antineutrino are attributed spins of $\frac{1}{2}$ and $-\frac{1}{2}$ respectively [see Abstracts 1092 and 1547 (1934).] C. A. S.

4130. Electric Transport of Active Deposit of Radium in Organic Solvents. Z. Klemensiewicz and (Miss) K. Projekt. *Acta Physica Polonica*, 2. 4. *pp.* 409–415, 1934. *In French.*—Radon was passed into the liquid to be examined (Et_2O, C_6H_{14}, C_6H_6, C_7H_8, $COMe_2$, EtOH, and solutions of $PhCO_2H$ in C_6H_6, $COMe_2$, or EtOH, and of $N(CH_2Ph)_3$ and NMe_4Cl in EtOH) in a closed vessel, the mixture allowed to stand 12 hr. and then electrolysed for 90 sec. with Pt electrodes and p.d. 440 V (giving a current of 2·5–13 mA. The activity of the electrodes was then determined and shown by log i/t curves (i current, t time). From these the amounts of RaA, RaB and RaC on kathode and anode were deduced. The curves for the pure solvents are all similar except for EtOH, the order of decreasing activity being Et_2O, C_6H_{14}, C_6H_6 and C_7H_8, $COMe_2$ and EtOH for the anode, and the same for the kathode save that $COMe_2$ comes after C_6H_{14}. The results are discussed and an explanation suggested based on the formation of groupings of atoms [see Abstract 2508 (1929)] and the varying mobility of the large ions thus formed in liquids of varying viscosity and dielectric constant. C. A. S.

4131. Actinium-Uranium Ratio in Radioactive Minerals. Ellen Gleditsch and E. Foeyn. *Comptes Rendus*, 199. *pp.* 412–414, *Aug.* 6, 1934.—By means of a modification of Boltwood's method, whereby the separation of thorium and ionium is facilitated, the Ac : U ratio for broeggerite, uraninite, and cleveite was determined as respectively 0·246, 0·237–0·246 and 0·241–0·246, average 0·243. From this, assuming the Io : U ratio to be 0·53, the percentage of Ac-U on U is 4·12. If Ac is derived from an isotope of U its period cannot differ much from that of UI [see Abstract 1544 (1934)]. C. A. S.

4132. Valencies of Polonium. M. Haïssinsky and M. Guillot. *J. de Physique et le Radium*, 5. *pp.* 419–425, *Aug.*, 1934.—The addition of increasing amounts of electrolyte to acid solutions of polonium causes a progressive displacement towards the negative of values of the critical potential of the kathode deposit. A strong displacement is observed in presence of traces of reducing agents. Chemical considerations of this result show that it is distinct from the electrolytic effect and can be attributed to a reduction of the polonium ions. In conjunction with evidence from crystallisation and isomorphism of polonium compounds a reduction of Po^{IV} to Po^{III} is indicated. N. M. B.

4133. Ionisation by α-Particles in Gaseous Mixtures. G. Glockler and R. Livingston. *J. Phys. Chem.* 38. *pp.* 655–660, *May*, 1934.—The calculation for the ionisation by α-particles from Rn in spherical vessels containing gaseous mixtures has been studied. The range of an α-particle in the mixture is $r_m = \mathrm{P}/\Sigma(\mathrm{P}/r)_i$. The stopping power of the gas mixture is $\mathrm{S}_m = \Sigma\ (\mathrm{PS})_i/\mathrm{P}$. The total ionisation relative to air (N.T.P.) is $g_m = \Sigma\ (g\mathrm{SP})_i/\Sigma\ (\mathrm{SP})_i$. The molecular ionisation of the gas mixture is given by $(g\mathrm{S})_m = (1/\mathrm{P})\ \Sigma\ (g\mathrm{SP})_i$. There are i components in the mixture and P is its total pressure. AUTHORS.

4134. Ionisation of Air by α- and β-Rays as a Function of Pressure. O. E. Polk. *Phys. Rev.* 46. *pp.* 405–406, *Sept.* 1, 1934.—Measurements of ionisation of air by α-particles from polonium and by β-rays excited by γ-rays, were made under usual laboratory conditions. The ionisation by β-rays increased at a decreasing rate with increase in pressure, in accordance with results obtained in previous investigations. The ionisation by α-particles decreased with increasing pressure, at first rapidly, then more slowly until, at 80 atmospheres, the value was approximately 5 per cent of that at atmospheric pressure.

AUTHOR.

4135. Heat Emitted by Absorption of Ra γ-Rays. I. Zlotowski. *Comptes Rendus,* 199. *pp.* 284–286, *July* 23, 1934.—A preliminary account is given of a measurement of the total energy of Ra γ-rays by absorption in the lead walls of a calorimeter. The calorimeter consisted of a set of concentric lead spheres so that the thickness of the absorbing walls could be varied. The heat emission attained a constant value for a thickness of 7 cm. After subtracting the heating effect due to the α- and β-radiation the figure obtained for the heat emission was 8·9 ± 0·3 cal. per gm. of Ra per hour. J. E. R. C.

4136. Absorption Coefficients of γ-Rays from RaC′. H. Katelaar, A. Piccard and E. Stahel. *J. de Physique et le Radium,* 5. *pp.* 385–388, *Aug.,* 1934.—The absorption coefficients of heavily filtered γ-rays from Ra are determined for different metals. For Al and Fe the observed absorption coefficients are in agreement to within 2 % with those calculated on the assumption of electronic absorption, using the Klein-Nishina formula. For other metals divergencies are found (referred to the effective cross-section per electron) proportional to the cube of the atomic number. The difference between the observed absorption and that calculated on the basis of electronic absorption is well-known to be due to nuclear absorption, but the results cannot be interpreted separately in terms of the two effects. F. C. C.

4137. Absorption of γ-Rays by the Method of Coincidences: Radiation of Excited Beryllium. P. Auger. *Comptes Rendus,* 199. *pp.* 414–416, *Aug.* 6, 1934.—Radiation from Be bombarded by α-particles from Po was examined by means of two counters, the wires of which were oxidised steel or Al and the cylindrical walls duralumin 0·2 mm. thick. When screens of Pb, Sn, Cu, Al or Li were placed between the two counters the number of coincidences increased in reverse order of the atomic numbers of the screen material. With the screen (Pb) of varying thickness between the source and first counter (with a preliminary screen of the same material to absorb the β-rays) the number of coincidences plotted against thickness of screen gives an exponential curve indicating 0·34 $\mathrm{cm.}^{-1}$ as the coefficient of absorption of the γ-rays in Pb, the difference from Bothe's results [see Abstract 4377 (1932)] being explained by the absence of effect of any neutrons emitted. C. A. S.

4138. Hydraulic Counter for Ionising Radiations. Part II. H. Greinacher. *Helv. Phys. Acta,* 7. 5. *pp.* 514–519, 1934. *In German.* —Further details are given concerning the hydraulic counter for ionising radiations previously described [see Abstract 3238 (1934)]. In particular it is pointed out that the deflection of the water jet can be increased by the addition of a condenser or by increase of the electrode capacity. It is found that the counter responds not only to ionising radiations entering the system from outside, but also when electrons are liberated from the water jet by illumination with ultra-violet light. The experiments show that the photoelectric effect of water is not confined to the extreme ultra-violet, but extends to the longer-wave region transmitted by quartz glass. L. A. W.

4139. Measurement of Strong Polonium Preparations. G. Ortner and G. Stetter. *Phys. Zeits.* 35. *pp.* 563–564, *Aug.* 1, 1934.—The essential point is to wash out thoroughly and then fill with very pure N (two methods of preparing which are described) the ionisation chamber in which the two plates are vertically above and at a distance from one another equal to the range of the α-particles, the upper being positive and the Po preparation lying on the lower. [See Abstract 1379 (1934).] C. A. S.

4140. Diffusion of Radioactive Recoil. (Miss) C. Chamié. *J. de Physique et le Radium,* 5. *pp.* 436–438, *Aug.*, 1934.—Langevin's theory of the diffusion of RaC$''$, giving a hyperbolic law of variation of activation due to recoil atoms as a function of the distance of the receiver from the source, is confirmed [see Abstract 2432 (1934)]. When the distance between the receiver and the source is less than the recoil range the quantity of ThC$''$ collected in absence of field was 8 %, and with saturated field 27 % of the total amount present in the source, showing the influence of readsorption of the recoil by the source. N. M. B.

See also Abstracts 3971, 3973, 3974, 3975, 3976, 3977, 4056, 4293, 4294, 4295, 4334.

RADIATION.

ABSORPTION AND TRANSMISSION.

4141. Spectrophotometric Investigations of Aqueous Cobalt Chloride Solutions. G. Spacu and J. G. Murgulescu. *Zeits. f. phys. Chem.* 170. *Abt.A.* 1–2. *pp.* 62–70, 1934.—Spectrophotometric measurements upon concentrated cobalt chloride solutions in presence of potassium chloride are made with a König-Martens spectrophotometer. Quantitative relationships between the observed absorption and the concentrations of cobalt ion and chloride ion are deduced. These relationships are discussed and possible explanations put forward. L. A. W.

4142. Spectrophotometric Investigations of Aqueous Cupric Chloride Solutions. G. Spacu and J. G. Murgulescu. *Zeits. f. phys. Chem.* 170. *Abt.A.* 1–2. *pp.* 71–80, 1934.—An account is given of spectrophotometric measurements [see preceding Abstract] upon concentrated solutions of cupric chloride in presence of potassium chloride. Determinations are made at wave-lengths of 436, 650 and 680 mμ. Quantitative expressions are found for the deviations from Beer's law. Explanations in terms of the formation of complex ions are put forward.
L. A. W.

See also Abstracts 4008, 4171, 4179, 4181.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

4143. Paramagnetic Rotation in a Variable Magnetic Field. G. Zanotelli. *Accad. Lincei, Atti,* 19. *pp.* 718–722, *May* 20, 1934.—In the study of the Faraday effect in a variable magnetic field two distinct questions arise: (1) whether it follows the variations of the field immediately or with a certain lag; (2) whether the magnitude of Verdet's constant varies with the rapidity of the field's variation. An experiment, following Beams' method, is here described to study the behaviour of the paramagnetic part of the Faraday effect in a variable field. It is found that the paramagnetic part of Verdet's constant ought in variable fields to differ from its value in constant fields by less than one-sixth of this same value, and that the paramagnetic rotation cannot follow the field's variation with a lag greater than 10^{-8} sec. A. J. McC.

4144. Magneto-Optical Dispersion of Organic Liquids in the Ultra-Violet Region of the Spectrum. Part VIII. Magneto-Optical Dispersion of Normal Butyl Acetate, Methyl Acetate and Ethyl Acetate. G. E. Jones and E. J. Evans. *Phil. Mag.* 18. *pp.* 386–400, *Aug.,* 1934.—Experiments by the same methods [see Abstract 1167 (1931)] are employed in the measurement of the magneto-optical rotations and the refractive indices of the three liquids. They show that Larmor's theory satisfactorily accounts for the variation of the magneto-optical rotation with wave-length, but leads to a very low value of *e/m*. It is possible that the magneto-optical dispersion involving only one band in the ultra-violet would have to be modified if rotations could be measured for shorter wave-lengths. [For Part VII see Abstract 1099 (1934).] H. M. B.

See also Abstract 4148.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

4145. Fluorescent and Phosphorescent Effects of Zinc Sulphide. L. Levy and D. W. West. *Brit. J. of Radiology*, 7. *pp*. 467–469 ; *Disc*., 470, *Aug*., 1934.—After a brief account of the fluorescent and phosphorescent properties of ZnS the authors showed that, by suitable treatment, it could be made to fluoresce under ultra-violet light with pink, orange, yellow, green, blue and white light. Under X-rays the fluorescence was shown to be more brilliant than that of cadmium tungstate, and under kathode rays (as in kathode-ray oscillographs) very bright traces, free of phosphorescence can be obtained. G. E. B.

4146. Fluorescence of Fluorocyclene and its Duration. M. Makowiecka. *Acta Physica Polonica*, 2. 4. *pp*. 357–369, 1934. *In French*.—In benzene solution 4 emission bands have been observed ; the fourth, on the red side for the first time. The spectra of fluorocyclene have also been studied in different solvents and it is observed that these depend on the solvent. The distribution of intensity is independent of the nature of the exciting light. In an acetone solution with cellulose all the bands have the same amount of polarisation. A measurement of the viscosity at different temperatures together with the polarisation gave according to the Perrin formula a value for the mean life of the excited molecule. This was found to be independent of the temperature and the viscosity ; as the temperature is lowered the bands shift towards the red and become narrower. J. E.

4147. Polarisation of Fluorescence. Part II. Solutions of Dyestuffs (continued). S. M. Mitra. *Indian Journ. Phys*. 8. *pp*. 445–450, *June*, 1934.—It was previously found that the polarisation decreased to a minimum and then increased, with decreasing wave-length. The minimum value is usually negative at about $\lambda=3131$. In this continuation of the work, different solvents were used—sugar solution, glycerin, castor oil, glycerin water and gelatin. Though the value of ρ is different in different solvents the minimum always occurred at $\lambda3131$. The theoretical discussion is reserved. [For Part I see Abstract 1979 (1934).] J. E.

4148. Influence of Magnetic Field on the Fluorescence of I_2, Te_2 and S_2 Vapours. J. Genard. *Physica*, 1. *pp*. 849–868, *July*, 1934. *In French*.—By use of the great Bellevue magnet measurements have been made of the magnetic extinction of the fluorescence of I_2, Te_2 and S_2 as a function of the intensity of the field. In the case of I_2, the theory of a magnetic predissociation, first proposed by Turner and van Vleck, appears to be confirmed for fields greater than 20,000 gauss. For weaker fields the deviations become more and more considerable. The parameters in the van Vleck formula for the percentage of extinction $Q=bH^2/(a+bH^2)$ are given here by $a/b=400$. The extinction of Te_2 fluorescence studied in the same way does not follow the van Vleck formula. A more complex extinction has been observed in the case of S_2, the value, as in the two previous cases, depending on the wave-length of the exciting light. Indeed certain resonance series appear to give enhancement under the field. It is considered that the results altogether give a reasonable general agreement with the van Vleck-Turner theory. J. E.

4149. Sensitising of Phosphors. S. Rothschild. *Phys. Zeits*. 35. *pp*. 557–560, *Aug*. 1, 1934.—CaS phosphors activated with Sa are only excited by ultra-violet light but may be sensitised to visible light by addition of traces of Bi. This effect appears to be quite exceptional since in other mixed phosphors the luminescence and its excitation exists independently for each phosphor except that the light of one is sometimes suppressed or weakened by the presence of the other. The enhancement of CaS-Sa light by addition of Bi does not appear to be explicable by supposing that the Bi light excites the Sa light since the excitation wavelengths for the latter are not in the Bi emission. A possible explanation is that the excited Bi centres suffer collisions of the second kind with the Sa centres and another is that the Bi forms part of the Sa centres. J. E.

4150. Microphotography of Fluorescent Screens. H. Funk and H. Steps. *Phys. Zeits.* 35. *pp.* 663–664, *Aug.* 15, 1934.—The grain size, homogeneity, and resolving power of fluorescent screens are compared by taking microphotographs of shadows of copper wires of different thicknesses which are cast on the screens by X-rays. J. T.

4151. Intensity Distribution of Light from Fluorescent Screens. H. Funk and H. Steps. *Zeits. f. techn. Physik*, 15. 8. *pp.* 301–306, 1934. The spectral intensity distribution of the light emitted by fluorescent X-ray screens and intensifiers is measured by the use of a Pulfrich photometer. It is found that for any one screen the intensity distribution is independent of the X-ray wave-length used. J. T.

INTERFERENCE. DIFFRACTION AND SCATTERING.

4152. Generalisation of the Michelson Experiment. L. Baumgardt. *Zeits. f. Physik*, 90. 5–6. *pp.* 327–330, Aug. 21, 1934.—A general expression for the fringe displacement is derived, in conjunction with the Lorentz contraction hypothesis, when both light beams in the interferometer pass through a dense refracting body. The relation between the calculated magnitude of the smallest displacement and the accuracy of measurement at present obtainable, is discussed, together with the influence of dispersion. [See also Abstract 1473 (1931).] W. D. W.

4153. Theory of Interference Effects in Ruled Films. J. Picht. *Zeits. f. Physik*, 90. 5–6. *pp.* 421–426, *Aug.* 21, 1934.—The intensity distribution in interference patterns produced by ruled films, can be readily calculated with close approximation by a formula which is valid when the interfering waves have the ideal cylindrical shape. The method is discussed and illustrated. [See also Abstract 2847 (1934).] W. D. W.

4154. Dispersion of the Phase Change for Reflection of Light from Thin Metallic Layers. J. Bauer. *Ann. d. Physik*, 20. 5. *pp.* 481–501, *Aug.*, 1934.—Thin layers of Ag, Au and Pt were produced partly by kathode scattering and partly by vaporisation in high vacua and the measurements in the visible region were made by modifying Fabry and Buisson's method. The optical arrangements and adjustments are explained. It was found that there was a close connection between the phase change and the absorption coefficient. The two modifications of silver found by Fabry and Buisson were shown to be identical with those of Ritschl. With non-homogeneous layers the phase change is not the same at different points. A theoretical investigation shows that the dependence of the phase change on wave-length is due to reflection within the metallic layers at the boundary surface. Thus while formerly the interference phenomena with the Fabry-Perot grating were considered as a 2-surface problem (Airy formula) they are conceived here as a 4-surface problem. It provides for the different metals the relation of phase change and wave-length found experimentally. R. S. R.

4155. Molecular Scattering of Light by Binary Gaseous Mixtures. R. Ananthakrishnan. *Indian Journ. Phys.* 8. 6. *pp.* 555–579, *June,* 1934.—This theoretical paper deals with the scattering of light by binary gaseous mixtures at high pressures where the ordinary gas laws are not valid. The scattering is due to (i) local density fluctuations of the mixture considered as one substance, and (ii) local fluctuations of composition. A scattering formula is derived by a thermodynamical method, and numerical computations are made for the cases of CO_2-H_2 and CO_2-O_2 mixtures. The results show that at the plait point of a binary gaseous mixture the composition scattering is preponderant. Scattering due to molecular anisotropy, which forms only a negligible part of the total scattering in the vicinity of the critical region, is not considered. L. A. W.

4156. Grating Interferometer. B. P. Ramsay. *J.O.S.A.* 24. *pp.* 253–258, *Sept.,* 1934.—Discussions of the Michelson interferometer indicate that fringes are formed by the superposition of two approximately parallel wave fronts. Wave fronts having the necessary characteristics can be obtained by mounting gratings on the arms of the interferometer in the places of the customary reflecting mirrors. The construction and action of such an interferometer has been studied; it is here described. The instrument becomes its own monochromator when the gratings are rotated to positions of minimum deviation for some particular wavelength. The customary form of the Michelson interferometet may be considered as the special case of the grating interferometer for which the grating space is large in comparison with λ. AUTHOR.

See also Abstracts **3994, 4179, 4190.**

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

4157. Effect of Light on Stannous Chloride Vapour. K. Butkow. *Phys. Zeits. d. Sowjetunion,* 5. 6. *pp.* 906–910, 1934. *In German.*—The absorption spectrum of $SnCl_2$ vapour has been investigated between 7000 Å and 2000 Å. Maxima of the continuous absorption have been established at 4130, 3204 and 2430 Å. It is further proved that the first and second maxima arise from the photodissociation of polymerised molecules of Sn_2Cl_4. H. H. Ho.

4158. Formation of Phosgene from Chloroform and Oxygen, Sensitised by Irradiated Chlorine. H. J. Schumacher and K. Wolff. *Zeits. f. phys. Chem.* 26. *Abt.B.* 6. *pp.* 453–462, 1934.—The formation of CCl_4 from $CHCl_3$ and Cl_2 in the light [see Abstract 2452 (1934)] is suppressed by O_2, sensitised formation of $COCl_2$ occurring simultaneously. The sensitised formation of $COCl_2$ follows the law $+d(COCl_2)/dt = k[CHCl_3]^{\frac{1}{2}}[I abs.]$. The temperature coefficient of the reaction is 1·23 ± 0·05, and the quantum yield, at 65° C. and a $CHCl_3$ pressure of about 100 mm. of Hg, 260 mol./E ± 15 %. The results obtained show marked analogies to those of the sensitised formation of CO_2 from CO, O_2 and Cl_2. T. H. P.

4159. Comparison of Reflection Densities Measured Photoelectrically and Visually. R. E. Owen and E. R. Davies. *Kodak Research Lab., Comm. No.* 529. *Phot. J.* 74. *pp.* 463–470; *Disc.,* 470, *Sept.,* 1934.—A number of difficulties are encountered in attempting to measure reflection densities photoelectrically, an important one being that the spectral sensitivity of the photoelectric cell differs from that of the eye. The effect of this is investigated and the conditions are determined for which the visual reflection density is equal to the photoelectric reflection density. A photoelectric experimental arrangement suitable for this determination is described, and numerous results are quoted showing how the two types of determination compare. A. H.

4160. Reduction Potential of Developers. W. Reinders. *J. Phys. Chem.* 38. *pp.* 783–796, *June*, 1934.—The germ theory of the latent image is outlined, followed by a description of a series of experiments performed to test certain deductions from the theory. It is shown that the latent image of a normally exposed photographic plate is not developed unless the developer has a reduction potential of at least 70 mV. below the Ag potential in the solution, whence it follows that the Ag germs in the latent image have a solubility about 25 times the normal solubility of large Ag particles. By addition of sodium citrate and malonate to a mixture of ferrous and ferric salt, solutions with great buffer capacity may be prepared, having a reduction potential between 0 and 300 mV. H. J. H. S.

4161. Temperature-Coefficient of Photographic Sensitivity. Part I. S. E. Sheppard, E. P. Wightman and R. F. Quirk. *Eastman Kodak Co., Research Lab., Comm. No.* 528. *J. Phys. Chem.* 38. *pp.* 817–830, *June*, 1934.—A study is made of the natural and optical sensitivities of dye-sensitised silver halides with particular regard to the influence of temperature below 20° C. It is found that, for a number of different plates, there is a small drop in sensitivity, both natural and optical, from − 70 to − 180° C. but a large drop from − 70 to − 180° C.; at − 180° C. there remains about 5 % of the original threshold sensitivity at 20° C. There appears to be less tendency to a diminution of sensitivity at very low temperatures for the natural (blue-violet) than for the optical (dye) sensitivity for the most sensitive grains; the changes in sensitivity become of the same order for grains of lower sensitivity. The literature on the subject is briefly reviewed, particularly that on the influence of low temperatures on absorption and the primary and secondary processes of latent image formation. H. J. H. S.

4162. Electrolysis of Photographic Plate. T. Takéuchi and N. Kawai. *Phys. Math. Soc. Japan, Proc.* 16. *pp.* 291–293, *Aug.*, 1934. *In German.*—Hauszer's experiment [see Abstract 1114 (1934)] was repeated with graphite cylinders (radius 1·2 cm.) as electrodes 2·1 cm. apart, and p.d. 114 V. The current $(3^{\frac{1}{n}}+t)^{-n}$ mA, (t=time since its application) was continued for 40–180 min., sometimes with reversal. The appearance on development (figured) indicate ionic diffusion [see Abstract 889 (1934)]. With angular electrodes linear markings radiate from the angles. C. A. S.

4163. Photographic Aspects of Sound Recording. C. E. K. Mees. *Roy. Soc. Arts, J.* 82. *pp.* 924–960, *July* 20, 1934. *Trueman-Wood Lecture.*—Describes the photographic problems which have arisen in connection with the recording and reproduction of sound, and gives a summary of the general conclusions reached. The author concerns himself mainly with the conditions necessary for sound recording, negative development, printing of the positive, and positive development, that is with the properties of the negative and positive photographic films and with the conditions for their use to ensure satisfactory sound reproduction. In the first part of the paper such points as the relation between γ and time of development, the Callier coefficient, variable density and variable width types of sound record, ground noises, and the method of noiseless recording are discussed. Then follows a discussion on the reproduction of frequency, dealing mainly with the variations of resolving power due to different causes. Finally, the reproduction of wave-form is considered, and three special instruments are briefly described—the variable slit sensitometer, the sound track densitometer, and a microdensitometer, developed to enable a direct experimental study to be made of the effects of any modification of the photographic process. Results of examinations made with these instruments are discussed and illustrated by typical graphs. R. C. F.

4164. New Photographic Sensitometer. K. Foige. *Fot. Indust.* 32. *pp.* 794–795, *July* 18, 1934.—Briefly describes an apparatus for determining photographic sensitivity with a time scale. An accurately driven sector is used in place of a neutral wedge, and the photographic material under examination is illuminated for 20 different time intervals. R. C. F.

4165. Time-Intensity Relation and Spectral Distribution of the Radiation of Photo-Flash Lamps. W. E. Forsythe and M. A. Easley. *J.O.S.A.* 24. *pp.* 195–197, *Aug.*, 1934.—Describes the spectral character of the light emitted by photo-flash lamps in which an aluminium foil is burnt in oxygen. Several bright lines, some bands and a continuous background were observed. The energy distribution in the spectrum was measured using a spectrometer, photoelectric cell and a ballistic galvanometer. The distribution, which refers to the integrated light throughout the whole flash, corresponded approximately to that of a black body of temperature 3500° K. for the wave-length range 3000 Å to 7500 Å. The curves showing the variation in intensity of the flash with time, were also determined. The flash begins at about 0·012 to 0·020 sec. after closing the ignition circuit, rises to a sharp maximum at 0·02 to 0·04 sec. and ends at 0·08 to 0·16 sec. The two times given in each case refer to lamps containing respectively 40 and 320 mg. of aluminium. W. S. S.

See also Abstracts 4081, 4245, 4249.

PHOTOMETRY.

4166. Iso-Candle Diagrams. A. Marsat. *Comptes Rendus,* 199. *pp.* 275–278, *July* 23, 1934.—Describes an alternative projection to the sinusoidal usually adopted for drawing iso-candle diagrams. J. W. T. W.

4167. Influence of the Purkinje Effect for Gas-Discharge Tubes. W. Dziobek and O. Reeb. *Phys. Zeits.* 35. *pp.* 545–548, *Aug.* 1, 1934. *From the Reichsanstalt.*—The light from a vacuum lamp (colour temperature 2360°) was matched in brightness with the light from sodium, neon and mercury discharge tubes at different levels of illumination of the photometer screen, down to 0·4 lux (m.c.). With the direct-comparison (contrast) photometer, the Purkinje effect became appreciable only at brightnesses less than 2 apostilb. With the flicker photometer no effect was observed for the colour difference with the vacuum lamp-mercury tube, but for the other cases, vacuum lamp-sodium tube and vacuum lamp-neon tube, the inverse Purkinje effect was obtained at the lower brightness levels. W. S. S.

4168. Linearity Test for Photoelectric Cells. P. Fleury. *Comptes Rendus,* 199. *pp.* 195–197, *July* 16, 1934.—Describes a method by which it is possible to add two illuminations on the kathode of a photoelectric cell. The light in a collimated beam from a tungsten lamp is divided into two approximately equal parts by transmission through a sheet of plate-glass inclined at 45°. The reflected and transmitted parts reach the same portion of the kathode surface and can be interrupted independently so that each separately or both together can be allowed to fall on the cell. This gives the relative response for illuminations E and *n*E where *n* is about 2. The intensity of the light can then be doubled and by successive measurements the complete response curve can be determined. J. W. T. W.

4169. Visual Spectrophotometry. K. S. Gibson. *J.O.S.A.* 24. *pp.* 234–249, *Sept.*, 1934.—The optical principles involved in visual spectrophotometry are illustrated by describing in detail equipments in use at the N.P.L. and at the Bureau of Standards, and instruments manufactured by various scientific instrument makers. Different forms of polarisation systems, rotating sectors of various forms, and variation of the current through a calibrated tungsten-filament lamp, are the methods used for varying light intensity in the instruments described. Factors affecting the reliability of spectrophotometric measurements are discussed. These include illumination and reference standards, wave-length calibration, stray light, slit widths, the reliability of the photometric scale, and the precision of measurement. D. H. F.

See also Abstracts 4141, 4142, 4159, 4165.

POLARISATION.

4170. Polarisation of General X-Radiation from Thick Targets. Y. F. Cheng. *Phys. Rev.* 46. *pp.* 243–247, *Aug.* 15, 1934.—The method applied in this experiment is that of 90° scattering combined with the balanced filter method. Bands of the X-ray spectrum between the *K*-absorption limits of Mo and Cb, of Pd and Rh and of W and Ta, from targets of W, Cu and Al have been tested for polarisation, using potentials from about 20 kV to 100 kV. Besides the confirmation of the previous experimental results about the relation between polarisation and voltage and the relation between polarisation and wave-length, two other points have been demonstrated more quantitatively. First, while the maximum experimental value of polarisation was not over 60 %, the polarisation at the quantum voltage of the band by extrapolation is nearly complete for all targets and all wave-length bands. Second, the polarisation of X-rays of a given wave-length from targets of lower atomic number is higher than that from targets of higher atomic number, except near the quantum voltage where they approach 100 %. AUTHOR.

See also Abstracts 4111, 4147, 4185.

RADIATION, EMISSION.

4171. Ultra-Violet Lamp. W. Ende. *Zeits. f. techn. Physik*, 15. 8. *pp.* 313–318, 1934.—The new lamp is of the mercury-vapour high-pressure type and has an envelope of " I.G. Phosphate glass." This glass has a linear expansion coefficient of 88×10^{-7}, and a softening point of 560° C. It is very transparent to ultra-violet radiation, and transmits 66 % of the incident radiation at a wave-length of 300 mμ. Full details of the construction of the lamp are given, together with its electrical characteristics and spectra in which the output of the new lamp with phosphate glass is compared with that of the same lamp with quartz, and it is shewn that below 300 mμ quartz is more transparent. G. E. B.

4172. Influence of Electric Waves on the Ionosphere. V. A. Bailey and D. F. Martyn. *Phil. Mag.* 18. *pp.* 369–386, *Aug.*, 1934.—A theoretical investigation is given, based on the methods and results of Townsend's investigations on the motion of electrons in gases, to show that in the passage of radio-waves through the ionosphere the mean velocity of agitation and the collision frequency of the electrons are not independent of the intensity of the waves. Thus Tellegen's observations are explained, in which the powerful Luxembourg station interfered with the signals received in Holland from Beromünster in Switzerland. Consideration must be given to the effect of the radiation field from lightning flashes, which increases the ionisation density of the ionosphere and may account for the prevalence of thunderstorms in the lower atmosphere. H. M. B.

4173. Magneto-Ionic Theory of Wave-Propagation by Means of Conformal Representation. V. A. Bailey. *Phil. Mag.* 18. *pp.* 516–523, *Sept.*, 1934.—By means of conformal representation a graphical method is established for the rapid detailed study of the propagation of plane electric waves in an ionised region of space where a constant magnetic field is also present. The two charts needed for the determination respectively of the polarisation and the refractive index are easily drawn, as they involve only circles, ellipses and parabolæ. AUTHOR.

4174. Cosmic Radiation. E. G. Steinke. *Ergeb. d. exakt. Naturwiss.* 13. *pp.* 89–147, 1934.—This paper gives an account of work done on cosmic radiation up the early part of 1934. A brief resumé of experimental methods is given first; the body of the paper is divided into three main sections dealing with (*a*) the incidence of cosmic radiation on the earth, (*b*) interaction of cosmic radiation and matter, and (*c*) temporal variations, and the relation between the radiation and other terrestrial phenomena. In conclusion a brief account of hypotheses concerning the origin of the radiation is given. A comprehensive Bibliography is appended. D. H. F.

See also Abstracts **4102, 4103, 4128, 4217, 4295, 4334, 4347.**

RADIATION, GENERAL THEORY.

4175. Photon Wave Equation. L. de Broglie. *Comptes Rendus,* 199. *pp.* 445–448, *Aug.* 13, 1934.—Difficulties in the theory previously reported [see Abstract 1139 (1934)] render it necessary to introduce modifications which would lead directly to a wave equation instead of starting from the Dirac equation. A new equation is proposed and discussed, which retains the main characteristics of the previous one and eliminates the anomalies. N. M. B.

REFLECTION. REFRACTION AND DISPERSION.

4176. Light Reflected from a Moving Mirror in Vacuo. Q. Majorana. *Accad. Lincei, Atti.* 19. *pp.* 754–759, *June* 1, 1934.—An account of various lines of research undertaken with the view of testing the ballistic theory of reflection from a moving mirror. The results are either inconclusive or, so far, tell against the ballistic theory. A. D.

4177. Reflection Factors of Very Thin Metallic Films. P. Rouard. *Rev. d'Optique,* 13. *pp.* 73–79, *March,* 1934.—Measures the reflection factors of very thin films of gold and silver on glass, the films being obtained by kathodic projection in anthracene vapour. The results obtained refer to reflections occurring at the air/metal and metal/glass surfaces of separation. With increasing gold film thickness the reflection factor for the metal/glass surface first decreases for each colour light used, and then increases in value rapidly, the minimum value of 0·002 being obtained with light of wave-length 5461 Å. The thickness of the film at which a minimum occurs varies with the wave-length, similar results being obtained with the silver films. Reflection factors obtained for the air/metal surfaces do not pass through a minimum although each curve has a fairly well defined change in direction. White light after reflection at the air/metal surfaces exhibits different colorations, dependent upon the film thickness. R. C. F.

4178. Condensation of Thin Metallic Films. T. V. Starkey. *Phil. Mag.* 18. *pp.* 241–256, *Aug.*, 1934.—Methods of measuring the film thickness of metallic deposits are difficult [see Abstract 1879 (1933)]. To overcome this, the thickness is given in terms of the time of growth of a deposit during its condensation on a quartz target from a molecular beam of cadmium vapour of constant density. The reflecting power of the target is measured *in situ* in a high vacuum, of which the residual gas is argon, by a photoelectric cell. The conclusions drawn are that active centres exist as a result of irregularities and uneven contamination of the target. The film begins to grow at these centres and the volume of the aggregates forming here are ranged about a mean volume according to the Gaussian law of errors. The growth is favoured by small particles only, probably molecules, and all the centres are occupied in a time which is short compared with the time of growth of the film. H. M. B.

4179. Optical Properties of Thin Films. M. Blackman. *Phil. Mag.* 18. *pp.* 262–272, *Aug.*, 1934.—A brief outline is given of the theory of transmission and reflection of light by a plate, and from it, various conditions of the ratio of the thickness to the wave-length are considered and compared with experimental results. Care must be taken not to confuse absorption maxima with interference phenomena and in the case of reflection from very thin films, the formula is not valid if reflection at the second surface causes interference. Surface layers have a marked effect on the optical properties of substances, such as polished metals; this varies with wave-length and is more prominent in the ultra-violet. Theory shows that reflection and absorption maxima coincide for crystals when the thickness is small compared with the wave-length and confirms experimental evidence. A series of thin films divided by air gaps reflects a much smaller percentage of the light than a plate of the same substance. H. M. B.

4180. Reflectivity of Intermetallic Systems. J. Wulff. *J.O.S.A.* 24. *pp.* 223–226, *Aug.*, 1934.—The alloy systems Al-Mg, Al-Si and Al-Ag have been studied. For the Al-Mg system, Mg-rich alloys exhibit a reflectivity resembling that of Mg. With alloys of about 50/50 concentration, which contain Mg_2Al_3 the reflecting power is greater than that of either of the pure metals. Alloys of Mg with Mg_2Al_3 (magnalium) have a reflectivity slightly above that of Al. For the Al-Si system the reflectivity of Al seems to predominate until the eutectic composition is reached. Beyond this even with 20 % Si alloys the low reflectivity of Si makes itself evident. In the Al-Ag system the reflectivity of the compound is definitely inferior to that of either chemical constituent. F. J. W.

4181. Opacity Standards. D. B. Judd. *Bureau of Standards, J. of Research*, 13. *pp.* 281–292, *Sept.*, 1934.—Opacity of paper is commonly specified by the contrast-ratio method. According to this method the reflectance of the material backed by a perfectly absorbing surface divided by its reflectance when backed by a highly reflecting material such as magnesium oxide is taken as an index of opacity. Magnesium oxide, itself is, however, commonly not used as the white backing because of its fragility; nor is the white backing placed in actual contact with the sample. Because of these and other sources of error, opacimeters frequently give erroneous results. Standards of opacity made of permanent material serve to check and to calibrate such instruments. Such standards made of opal glass are described, the theory of their application is given, and results of tests by their use reported. It is found that T.A.P.P.I. (Technical Association of Pulp and Paper Industries) opacity corresponds to a reflectance of white backing in contact with the sample of about 0·89. AUTHOR.

4182. Dependence of Slit Image Formed by a Cylindrical Lens on Breadth of the Illuminated Slit and Width of Bundle. J. Picht and W. Philippoff. *Zeits. f. Instrumentenk*, 54. *pp.* 253–264, *Aug.*, 1934. —Mathematical expressions are obtained for the intensity distribution in a plane perpendicular to the direction of the slit and particularly that in the line of intersection of this plane with the plane of the image. An ideal image is assumed but it leads to no essential limitations. The mathematical expressions are set out for obtaining by graphical integration the intensity distribution in terms of the slit-diameter and the width of the bundle for a given wave-length. It is found that for broader slits the intensity at the edges of the slit image decreases first to half of the maximum intensity but with smaller slits it approximates to the maximum intensity. Diagrams show how the maximum intensity, in spite of constant width of the bundle, decreases strongly with decreased width of the object. From curves it is possible to choose the most favourable slit-width for registration purposes. R. S. R.

4183. Quantitative Optical Test for Telescope Mirrors and Lenses. J. H. King. *J.O.S.A.* 24. *pp.* 250–252, *Sept.*, 1934.—Light from an optical slit is brought to a focus by the mirror or lens under test. A single tensioned wire of about 0·003 to 0·006 in. dia. is placed just in front of focus and arranged symmetrically on the axis of the returning cone parallel with the optical slit. The images of two parallel gauge slits, illuminated with a contrasting colour, are symmetrically superimposed on the speculum image by means of an unsilvered diagonal or equivalent. The gauge slits are also arranged to look parallel to the optical slit image. The eye, when placed at the focus of the returning cone, sees the shadow image of the test wire and the image of the gauge slits against the illuminated speculum. By moving the test wire along the axis of the returning cone, its shadow image is expanded and made to touch or intersect the parallel gauge images at the various zonal radii of the mirror under test. The motion of the wire is a direct measure of the aberration existing between those respective zonal radii. The geometry of the test is described and a few sketches show the appearances of some of the common forms of aberration. AUTHOR.

4184. Molecular Refractivity and Association of Liquids Containing the Hydroxyl Group. R. P. Allard and H. H. Wenzke. *Am. Chem. Soc., J.* 56. *pp.* 1693–1694, *Aug.*, 1934.—It has been shown that the changes in molecular refractivity of a solute with dilution do not constitute a simple test of association of hydroxyl compounds. There is no evidence from this source to disprove the type of coordination suggested by Sidgwick. AUTHORS.

4185. Method of "Flutings" Applied to Retardation Measurements upon a Crystalline Plate Showing Dispersion of the Birefringence. H. Brasseur and J. Piérard. *Zeits. f. Krist.* 89. *pp.* 24–31, *Aug.*, 1934. *In French.*—A continuous spectrum will be crossed by a series of flutings, from which the wave-length, and consequently the retardation of the plate, can be deduced. Applications are made to a case showing dispersion of the birefringence, to the case of quartz, and to the compound $CaPt(CN)_4 \cdot 5H_2O$. The same methods are applicable to the determination of rotatory power. F. I. G. R.

4186. Aplanatic System of Two Mirrors. F. Bureau and P. Swings. *Rev. d'Optique*, 13. *pp.* 127–132, *April*, 1934.—The system has been studied for a point source situated at a finite distance. The result is given as the rigorous solution of a differential equation expressing the conditions of the problem. The system may be of practical value for the illumination of the microscope. W. D. W.

4187. Theodolite Compass. *Rev. d'Optique*, 13. *pp.* 133–140, *April*, 1934.—The paper describes an improved form of theodolite compass, not of the highest accuracy (readings are taken to 1 minute), but rapid, convenient and reliable. The outstanding feature of the design is the prism system by which opposite diameters of the circle are brought into the eyepiece at the same time. W. D. W.

4188. Cell for Refractivity Measurements on Minute Crystals. F. I. G. Rawlins and C. W. Hawksley. *Journ. Sci. Instruments*, 11. *pp.* 282–284, *Sept.*, 1934.—A glass cell is described, designed for the determination of the refractive indices of minute crystals. The cell can be used upon the stage of any polarising microscope. The crystal is mounted upon a small holder, which is bodily inserted into the cell, containing the comparison liquid. Evaporation is reduced to a minimum. Index determination follows by the Becke-line method. AUTHORS.

See also Abstracts 4032, 4079, 4144, 4154, 4159, 4260, 4280.

SPECTROSCOPY.

4189. Wave Numbers of Infra-Red Spectral Lines Beyond λ10,000. H. D. Babcock. *Phys. Rev.* 46. *pp.* 382–383, *Sept.* 1, 1934.—Kayser's well-known *Tabelle der Schwingungszahlen* may be used for wave-lengths beyond λ10,000 by merely interchanging the labels of the two quantities tabulated. The vacuum wave-number thus derived, though not exactly correct, is sufficiently accurate for most of the data now available. For higher accuracy small corrections are tabulated. AUTHOR.

4190. Interference Measurements in the Spectra of Noble Gases. W. F. Meggers and C. J. Humphreys. *Bureau of Standard J. of Research*, 13. *pp.* 293–309, *Sept.*, 1934.—Employing the Fabry-Perot étalon interferometer, the wave-lengths corresponding to lines in the first spectra of the noble gases have been measured relative to the fundamental standard of wave-length (Cd 6438·4696 Å), and to selected red lines of neon previously compared with the primary standard. The observations range from the violet (3948 Å) to the infra-red (10830 Å). Values are given for 3 lines of He, 172 of Ne, 87 of A, 55 of Kr, and 130 of Xe. Many of the lines have been found to be reproducible to eight figures, and are regarded as highly satisfactory standards in spite of objections which have been raised against them on account of isotopic hyperfine structure. AUTHORS.

4191. Forbidden Lines in the Neutral Lead Spectrum. H. Niewodniczański. *Acta Physica Polonica*, 2.4. *pp*. 375–382, 1934. *In English*.—The spectrum was excited in a quartz electrodeless tube using a 6-m. oscillator. The tube could be heated in a furnace, and measured quantities of He or A introduced. Of the four lines measured, 4618·0, 5312·7, 4659·4 and 7330 Å, only the first could be excited in pure Pb vapour, the remainder requiring the presence of inert gas. The first is explained as a pure magnetic dipole radiation, the second and third as pure quadripole radiation and the last as a mixture of the two. F. S.

4192. Axiality of Emission of the Hydrogen Lines, 1025 and 1215 Å. R. Frerichs and H. Bomke. *Phys. Zeits*. 35. *pp*. 549–551, *Aug*. 1, 1934. *From the Reichsanstalt*.—A special tube is described in which the canal stream passes between a field-electrode and the slit of a vacuum spectrograph. Four components were found in the 1025 Å line whose intensities were compared with reference to the oxygen triplet 1302–1306 Å. A special ring electrode was used in the case of the 1215 Å line. It is concluded that the intensity of emission is the same whether or not it is unidirectional. F. S.

4193. Multiplets in the Ag III Spectrum. B. V. R. Rao. *Indian Acad. Sci., Proc*. 1. *pp*. 28–33, *July*, 1934.—By a consideration of the isoelectronic sequence RhI, PdII and AgIII, the terms $4d^8(^3F)5s\ ^4F$ and ^2F and $4d^8(^3F)5p\ ^4F'$ and $^2F'$ of AgIII have been identified. The Moseley diagram for the corresponding terms of the members of the sequence is also given in the paper. The absolute value of the term $4d^8(^3F)5s\ ^4F_{9/2}$ comes out as equal to 237000·0 cm.$^{-1}$ corresponding to an ionisation potential of about 29·25 volts. AUTHOR.

4194. Absorption Spectra of the Samarium Ion in Solids. Part IV. F. H. Spedding and R. S. Bear. *Phys. Rev*. 46. *pp*. 308–315, *Aug*. 15, 1934.—The absorption spectrum of hexagonal $Sm(C_2H_5SO_4)_3 \cdot 9H_2O$ has been investigated in the temperature range 20° to 295° K. It is found to be simpler than that of the monoclinic $SmCl_3 \cdot 6H_2O$, previously reported. This is in agreement with theoretical conclusions that the greater symmetry of the hexagonal lattice should give rise to crystalline fields which would cause the energy levels of Sm^{+++} ion to be split apart less and to be in some cases more degenerate than would the more unsymmetrical monoclinic lattice. The ethylsulphate lines seem to be related chiefly to three lower levels, the basic one and two which are located higher on the energy scale by 55 and 65 cm.$^{-1}$, respectively. Complete figures are given for the ethylsulphate absorption in the visible region. In addition results for the iodide and perchlorate of samarium are summarised. The lower levels found to be most important in these salts are situated at 0, 90, 107 cm.$^{-1}$ for the iodide; and 0, 104, 160 cm.$^{-1}$ for the perchlorate. [For Part III see Abstract 4501 (1933).] AUTHORS.

4195. Singlet Lines of Cl IV. I. S. Bowen. *Phys. Rev*. 46. *p*. 377, *Sept*. 1, 1934.—Ten singlet and intercombination lines of Cl IV have been classified and the singlet terms of the ground configuration located. Forbidden transitions between the terms of the ground configurations of Cl IV, Cl III and probably S III are not observed in nebulæ or novæ. AUTHOR.

4196. Spectra of Neon in the Extreme Ultra-Violet. J. C. Boyce. *Phys. Rev*. 46. *pp*. 378–381, *Sept*. 1, 1934.—Increased dispersion and resolving power have made possible a revision and extension of previous work on the spectra of neon in the extreme ultra-violet. Lists of classified lines are given for Ne I, Ne II, Ne III and Ne IV in the range from λ2000 to λ 282. No new lines were found for Ne I but the accuracy of the wavelengths is considerably improved. For the other stages of ionisation the number of lines identified or resolved has been doubled. Term tables are given for Ne II, Ne III and Ne IV including in them the results of other workers, notably de Bruin, from investigations in the more accessible portion of the spectrum. AUTHOR.

4197. Relative Multiplet Transition Probabilities from Spectroscopic Stability. C. W. Ufford and F. M. Miller. *Phys. Rev.* 46. *pp.* 283–285, *Aug.* 15, 1934.—With the method based on the principle of spectroscopic stability, the relative transition probabilities of different multiplets in Russell-Saunders coupling have been calculated for the transitions $d^3p - d^4$, $dp^2 - pd^2$, and $d^2p^2 - d^3p$. A formula is given for getting the transition probabilities, in terms of the core transition probabilities, for the pair of electron configurations which are obtained by adding the same non-equivalent *s* electron to each core configuration.
AUTHORS.

4198. Kinetic Energy of Polyatomic Molecules. C. Eckart. *Phys. Rev.* 46. *pp.* 383–387, *Sept.* 1, 1934.—The Lagrangian and Hamiltonian expressions for the kinetic energy of a system of *n* particles are obtained in such a form that the rotational, vibrational and coupling terms may be distinguished. The principal axes of inertia are used to define rotation. The ordinary moments of inertia appear in the Lagrangian kinetic energy but these are replaced by other functions of the radii of gyration in the Hamiltonian. This throws doubt upon all molecular configurations assigned on the basis of empirical values of the moments of inertia. AUTHOR.

4199. Normal Vibrations of SF_6. A. Eucken and H. Ahrens. *Zeits. f. phys. Chem.* 26. *Abt.B.* 4–5. *pp.* 297–311, 1934.—Five out of the six normal vibrations of SF_6 which are optically active in part as Raman lines and partly as infra-red bands, have been confirmed by corresponding spectroscopic measurements. The last vibration, which is inactive both in the Raman and infra-red spectrum, is determined from the temperature relationship of the molecular heat. The surplus bands which occur in the infra-red spectrum can be identified as combination vibrations in good agreement with the selection rules which are valid for an octahedral molecule. Full experimental details are included. H. H. Ho.

4200. Spectrum of O_4. W. Finkelnburg. *Zeits. f. Physik,* 90. 1–2. *pp.* 1–10, *July* 24, 1934.—From investigation of the spectra of solid, liquid and highly compressed oxygen, it is concluded that their properties are due to an O_4-polarisation molecule. From the width of the visible bands, an approximate value of the dissociation energy of the excited O_4-state is found to be a few hundredths of a volt. From the behaviour of ultra-violet bands the existence of further polyatomic polarisation molecules is expected. F. S.

4201. Infra-Red Spectrum of Magnesium Oxide. J. Fock. *Zeits. f. Physik,* 90. 1–2. *pp.* 44–47, *July* 24, 1934.—The infra-red spectrum of MgO has been explored between 2·8 and 200μ. A fundamental frequency was found at 17·3μ in fair agreement with the value (18·7μ) calculated by Debye's method from specific heat data. Another band occurs at 6·7–6·8μ. W. R. A.

4202. Band Spectrum of NaK. F. W. Loomis and M. J. Arvin. *Phys. Rev.* 46. *pp.* 286–291, *Aug.* 15, 1934.—The spectrum of the NaK molecule has been studied in absorption and in magnetic rotation throughout the visible and photographic infra-red regions. By means of magnetic rotation the upper vibrational levels of the orange system have been followed nearly to dissociation, permitting accurate determinations of the energies of dissociation of four states of the molecule, that of the ground state being 0·62 ± 0·03 volt. Two new band systems, in the green and infra-red, have been found and analysed. The fourth theoretically expected system has not been found and is presumably covered by strong Na_2 and K_2 systems. The magnetic rotation spectra in the green and red have no simple relation to the absorption spectra and are probably to be interpreted as due to perturbations, like the red magnetic rotation spectrum of Na_2. [See Abstract 3701 (1932).] AUTHORS.

4203. Band Spectrum of Cæsium. F. W. Loomis and P. Kusch. *Phys. Rev.* 46. *pp.* 292–301, *Aug.* 15, 1934.—Measurements of five distinct band systems of Cs_2 have been made, in absorption with high and low dispersion, in magnetic rotation, and in fluorescence. Three of these systems, with maxima at 6250, 7200, and 7667 Å, have been reported before, but not analysed. The fourth with a maximum at 4800 Å and the fifth, extending from 8950 Å to limit of sensitivity of the plate, are new. Quantum numbers have been assigned to some 218 bands in the system at 7667 Å. The upper and lower vibrational frequencies are 34·28 and 41·99 cm.$^{-1}$, and an extrapolation yields 0·45 volt as the energy of dissociation of the ground state. This system, and the one beyond 8950 Å, apparently correspond to the green and red systems of sodium, respectively. The origin of the fifth system lies beyond the region of sensitivity of even the new Eastman *Q* plates. Some regularities in the other systems have been found, but no complete analysis could be made, though a fluorescence spectrum was obtained in the 6250 system which showed the lower state to be the same as in the 7667 Å system. This 6250 Å system is extraordinarily complex and appears to contain some bands degraded to the red, some to the blue and some narrow regions of absorption bounded by edges on both sides. No magnetic rotation spectrum was found. AUTHOR.

4204. Infra-Red Absorption Spectrum of Water Containing Deuterium. J. W. Ellis and B. W. Sorge. *J. Chem. Phys.* 2. *pp.* 559–564, *Sept.*, 1934.—Absorption percentages for the region 1–10μ are presented for one sample of water, 60 % of whose hydrogen is deuterium, and for a second sample containing 99·5 % deuterium oxide. Maxima are picked out as the three fundamental frequencies for the molecules DOD and HOD. These are compared with values predicted by an isotopic shift calculation based on data chosen from the spectrum of ordinary water. All other higher frequency maxima are interpreted as overtones or combination bands, but only after a fourth fundamental frequency is chosen in the examples of HOH and DOD. AUTHORS.

4205. Infra-Red Absorption of Alcoholic Solutions of Hydroxides. E. K. Plyler and F. D. Williams. *J. Chem. Phys.* 2. *pp.* 565–566, *Sept.*, 1934.—Bands have been observed at 0·76μ, 0·95μ, 1·05μ, 1·27μ, 1·30μ, 1·73μ, 1·89μ, 2·30μ, 2·60μ, 3·80μ and 5·20μ in alcoholic solutions of hydroxides. Solutions of NaOH and KOH gave the same positions for the bands. It was found that if the bands at 3·80μ and 5·20μ were considered as fundamentals, the remaining bands could be classified as harmonics. The similarity of the observed bands of the alcoholic solutions to the bands of aqueous solutions is mentioned. AUTHORS.

4206. Band Spectrum of Se_2. E. Olsson. *Zeits. f. Physik*, 90. 1–2. *pp.* 138–144, *July* 24, 1934.—The rotational structure of Se bands in the region 3700 to 3900 Å signifies a $^1\Sigma_u^+ \rightarrow {}^1\Sigma_g^+$ system. Predissociation and isotopic effects are briefly mentioned. Se_2 has no nuclear spin. W. R. A.

4207. Band Systems of BaCl. A. E. Parker. *Phys. Rev.* 46. *pp.* 301–307, *Aug.* 15, 1934.—Three band systems of BaCl have been analysed by means of spectrograms taken in the second order of two 21 ft. gratings. The green system (λ5047 to λ5322) is a $^2\Pi - {}^2\Sigma$ transition and due to the nearly equal values of ω for the two electronic states is composed of only the $\Delta v = 0, \pm 1$ sequences. There are two ultra-violet systems with (0,0) bands at λ3922 and λ3692, respectively. Both are presumably $^2\Sigma - {}^2\Sigma$ transitions and have broader Franck-Condon parabolae than the green system. The isotope effect of Cl^{35} and Cl^{37} is observed but in none of the systems could any bands be definitely attributed to barium isotopes other than Ba^{138}. The dissociation products are discussed. AUTHOR.

4208. Relative Intensities of the Bands of the $N_2\alpha$ System. F. Cavalloni. *Zeits. f. Physik*, 90. 5–6. *pp.* 342–347, *Aug.* 21, 1934.—The relative intensities of the $N_2\alpha$ bands between 7700 and 5700 Å are measured for the arc and fluorescent spectra. From these the values of the excitation function is investigated, and the results bear out Kaplan's conception of active N_2. J. P. A.

4209. Relation between Vibration Frequency and Nuclear Separation for Simple Non-Hydride Diatomic Molecules. C. H. D. Clark. *Phil. Mag.* 18. *pp.* 459–470, *Sept.*, 1934.—It is suggested that Morse's rule ($\omega_e r_e^3 = 3 \times 10^{-21}$) may be modified by the introduction of the appropriate group number and a period constant, with an allowance for ionised states of diatomic molecules of non-hydride type, the modified equation being $\omega_e r_e^3 \sqrt{n} = k - k'$, where n is the group number, k is a constant for a given molecular period and k' is a correction for the case of an ionised molecule. The modification is applied to cases where at least one of the two constituent atoms of a non-hydride diatomic molecule has no more than one K ring in its completed group, and the average error from the experimental results is of the order of 1%. Values of r_e for 36 electronic states of diatomic molecules of the prescribed type are predicted. A. H.

4210. Quenching of Mercury Resonance Radiation by Hydrogen, Carbon Monoxide and Nitrogen. O. S. Duffendack and J. S. Owens. *Phys. Rev.* 46. *pp.* 417–424, *Sept.* 1, 1934.—An investigation was made of the dependence upon the temperature of the quenching of mercury resonance radiation by H_2, CO and N_2. The quenching by H_2 was effectively independent of the temperature from 473° K. to 973° K., but that by CO and by N_2 decreased with increasing temperature. This decrease was somewhat more marked in N_2 than in CO. These results show that the metastable 2^3P_0 state of the Hg atom is involved in the quenching by CO and by N_2, but not appreciably in the quenching by H_2. The quenching by H_2 may be accounted for by a reaction involving the dissociation of the H_2 molecule by collision with a 2^3P_1 Hg atom, followed in a certain small fraction of the cases by the probable excitation by collision with a second 2^3P_1 atom of the mercury hydride molecule so produced. The effective cross-sections for energy transfer in the first process at the different temperatures are given. The quenching by CO and by N_2 may be accounted for by the transition $2^3P_1 \rightarrow 2^3P_0$ of the

Hg atoms at gas collisions, by the return of some of the 2^3P_0 atoms to the 2^3P_1 state at subsequent gas collisions, and by the reduction of the remainder of them by several distinct processes to the 1^1S_0 state. The effective cross-sections for the different processes are given. AUTHORS.

4211. Dark Interval in Mercury Fluorescence. (Lord) Rayleigh. *Roy. Soc., Proc.* 146. *pp.* 272–280, *Sept.* 1, 1934.—It appears from the experiments recorded that the phenomenon of the dark interval only occurs in the visual Hg fluorescence, which has a continuous spectrum, photographic maximum 4850 Å, and visual maximum in the green. The ultra-violet maximum at 3300 Å does not show it, nor does the fluorescence at or near the line 2537 Å. Further, even in the visual fluorescence, the appearance of the dark interval is dependent on the source of excitation. It is most conspicuous when the Al, Zn or Cd sparks are used, exciting on the long-wave side of the $1^1S_0 - 1^1P_1$ line of Hg ; less conspicuous with the hot Hg lamp or the iron arc exciting on the long-wave side of the $1^1S_0 - 2^3P_1$ line of Hg ; and altogether absent with the cooled Hg arc, exciting exactly at the $1^1S_0 - 2^3P_1$, line of Hg (atomic excitation). The following negative conclusions are drawn from the data since a definite explanation cannot yet be given. The dark interval cannot be attributed to the time-interval required for transition from the 2^1P to the 2^3P state of the molecule for it occurs in some cases when only the 2^3P state is involved, nor to any delay in forming molecules from 2^3P_1, neither is it inherent in the final process which leads to the emission of the green visual fluorescence. H. H. Ho.

4212. Zeeman Effect in Argon I Spectrum. J. Terrien and H. Dijkstra. *J. de Physique et le Radium*, 5. *pp.* 439–444, *Aug.*, 1934.—Measurements were made with a large Rowland grating mounted stigmatically, both of the $1s - 2p$ lines in the infra-red and the $1s - 3p$ lines in the violet. All values of g are abnormal showing, from known disposition of terms, that the coupling is intermediate. Contrary to Preston's rule, the homologous lines have different decomposition. Comparison is made with other work on the $2p$ terms of Kr. F. S.

4213. Raman Effect and Molecular Constitution. Part VII. Cis- and Trans-Dichlorethylene and Methylene Bromide. B. Trumpy. *Zeits. f. Physik*, 90. 1–2. *pp.* 133–137, *July* 24, 1934.—Polarisation measurements of *cis*- and *trans*-dichlorethylene and methylene bromide have been made. From the measurements and Placzek's symmetry considerations the structure of the molecule is discussed. W. R. A.

4214. Raman Effect of the Hydroxyl Group. L. Médard. *Comptes Rendus*, 199. *pp.* 421–423, *Aug.* 6, 1934.—The Raman spectra of anhydrous formic acid, glycol monochlorhydrin and hydroxylamine, excited by Hg 4046 Å, are photographed using a filter of cobalt chloride solution and Corning glass No. 306 in the incident beam and a filter of sodium nitrite in the scattered beam. All the substances give Raman bands lying in the region 3000 to 3700 cm.$^{-1}$ which are ascribed to the hydroxyl group. Experiments with anhydrous glycerin indicate that the intensity of the continuous background of the Raman spectrum is diminished by careful purification. L. A. W.

4215. Raman Spectrum of Fluorobenzene. F. W. Crawford and J. R. Nielsen. *J. Chem. Phys.* 2. *pp.* 567–571, *Sept.*, 1934.—The Raman spectrum of fluorobenzene has been investigated with a Hilger E1 quartz spectrograph, the following frequency shifts being obtained : 241, 517, 613, 804, 829, 997, 1009, 1157, 1220, (1265), (1414), 1496, (1561),

1599, 3076 and 3677 cm.$^{-1}$. Relative intensities were measured with a Zeiss three-prism glass spectrograph and a Moll microphotometer.
AUTHORS.

4216. Raman Spectra of Isomeric Octanes. J. W. Murray. *J. Chem. Phys.* 2. *p.* 618, *Sept.*, 1934.—The Raman spectra of 3, 4-dimethylhexane and 2, 5-dimethylhexane have been examined using the technique described by Murray and Andrews [see Abstract 3605 (1933)]. AUTHOR.

4217. Radiation from Interior of Arc. T. Peczalski. *Comptes Rendus*, 199. *pp.* 405–407, *Aug.* 6, 1934.—It is found that the radiation from the interior of a carbon arc, between a hollow carbon and one cored with CaF_2, shows the spectra of Ca, C, N and O. The spectrum of the outer layers is chiefly due to CaF_2. The ionisation of the gases in the arc was increased by placing another arc beneath it. The voltage-current characteristic of the arc under these conditions, with small and large cores of CaF_2, was compared with that of the simple arc, and was found to be linear over the small ranges of voltage considered. D. H. F.

4218. Quantitative Spectrographic Analysis: Application to Silicon. H. Triché. *Comptes Rendus*, 199. *pp.* 419–421, *Aug.* 6, 1934.—Three spectroscopic methods are shown to be suitable for the quantitative estimation of Si in light alloys containing a high percentage of Al. In the first method the alloy is dissolved and a definite concentration of stannic chloride is added to the solution. A spark is then passed between a zinc electrode and the solution and the concentration of Si determined from the relative intensities of the Si line 2881Å and the tin line 2840Å. When the Si content is less than 0·5 % it is found more advantageous to use a second method in which the spark is passed between the solid alloy and the solution containing the comparison metal, which is again tin in the form of stannic chloride. Finally it is found possible to use, instead of a spark, an arc between the alloy and an alloy containing the comparison metal. L. A. W.

See also Abstracts 3988, 3992, 4022, 4151, 4157, 4288.

VISION.

See Abstract 4167.

X-RAYS.

4219. Oscillographic Study of the Electrical Characteristics of X-Ray Generators. G. W. C. Kaye and G. E. Bell. *Brit. J. of Radiology*, 7. *pp.* 476–508, *Aug.*, 1934.—Gives results of an oscillographic study of modern X-ray generators, including half-wave generators of the pulsating and constant voltage types, Villard and Greinacher generators. It is shown that X-ray h.t. transformers frequently show resonances, which may give rise to serious distortions of the wave forms, and that the efficiency of half-wave generators is low chiefly on account of the asymmetrical magnetising cycle to which the transformer core is subjected. Constant voltage generators of the condenser type are found to behave generally in accordance with simple theory. In certain cases this type of generator is liable to produce high overvoltages when first switched on. The output wave form of Villard generators is found to depart markedly from sinusoidal form, particularly at higher currents. G. E. B.

4220. 5-kW X-Ray Generator with a Spinning Target. R. E. Clay. *Phys. Soc., Proc.* 46. *pp.* 703–712, *Sept.* 1, 1934.—A considerable increase in power can be obtained by moving the target of an X-ray generator. A detailed account is given of the design and construction of a successful machine in which the target is a water-cooled rotating disc.

AUTHORS.

4221. Quantitative Test of the Waller-Hartree Theory of X-Ray Scattering. G. G. Harvey, P. S. Williams and G. E. M. Jauncey. *Phys. Rev.* 46. *pp.* 365–367, *Sept.* 1, 1934.—The effect of the extra term in the incoherent part of the scattered radiation due to the operation of the Pauli exclusion principle is calculated for neon. It is shown that the inclusion of this term gives considerably better agreement with experimental results for NaF; it is further pointed out that it is probably only in the case of the diffuse scattering from crystals that the effect of this term can be detected experimentally. AUTHORS.

4222. Modification of Moseley's Law. V. Dolejšek. *Acta Physica Polonica*, 2. 4. *pp.* 439–446, 1934. *In French.*—A further discussion, with reference to measurements for the lighter elements, of the modified Moseley law $\nu/R = a + bN + cN^2 + dN^3 + eN^4$, previously described. [See Abstracts 1886 and 2200 (1929).] C. B. A.

4223. Absorption of X-Rays in the Antikathode of a Low Voltage Ionic Tube. V. Kunzl. *Acta Physica Polonica*, 2. 4. *pp.* 447–457, 1934. *In French.*—Investigations of the M-absorption of Ta and W, as exhibited when the metals are used as target in the X-ray tube, without any further absorbing screen, are described. The spectrum obtained is purely selective, M_I and M_{II} only being observed, whilst M_{III} and M_{IV} are entirely absent in each case. Evidence is adduced to show that this type of spectrum is obtained only when the absorption occurs in the metal target. C. B. A.

4224. Excitation of the H_2-Cl_2 Reaction by X-Rays. S. Götzky and P. Günther. *Zeits. f. phys. Chem.* 26. *Abt.B.* 4–5. *pp.* 373–389, 1934. —The velocity of the X-ray reaction in H_2-Cl_2 mixtures follows Bodenstein and Dux's formula, the reaction, like that occurring in the light, being a chain reaction. For the formation of 1 mol. of HCl 7·8 cal. are found necessary, the chain-length being $9 \cdot 1 \times 10^3$. The energy of the secondary electrons is insufficient to effect chemical excitation and ionisation together in the gas, and the excitation of the reaction must be related to the appearance of ions. From the energy-balance of the X-ray reaction the number of excitations per ion is calculated as 3 to 4, which agrees satisfactorily with direct determinations; the energy of recombination of the ions appears to play no part. These results are in complete accord with Lind's cluster theory. Copper surfaces irradiated with X-rays retard the X-ray reaction in the same way, as when non-irradiated, they retard the reaction in the light, but silver surfaces are without influence. T. H. P.

4225. Reduction of Oxygen to Hydrogen Peroxide by X-Rays. H. Fricke. *J. Chem. Phys.* 2. *pp.* 556–557, *Sept.*, 1934.—Irradiation with X-rays produces no chemical change in air-free water. With oxygen present, hydrogen peroxide is formed due to a primary activation of the water. The initial production of hydrogen peroxide is independent of the oxygen pressure, from 4 to 70 cm. Hg and is dependent on the hydrogen-ion concentration according to:

$$\frac{H_2O_2}{1000r \times 1000 \text{ c.c.}} = \left[2 \cdot 2 + 2 \cdot 2 \frac{10^{9 \cdot 6 - pH}}{1 + 10^{9 \cdot 6 - pH}}\right] 10^{-6}\text{N}.$$

AUTHOR.

4226. Investigations of Thin Layers of Nickel by X-Rays. R. Riedmiller. *Ann. d. Physik,* 20. 4. *pp.* 377–403, *July,* 1934.—Measurements were made of the density, the refractive index for X-rays, and the specific electric resistance of thin layers of nickel in dependence on the thickness or the density. The range of thickness investigated lay between 400 and 1750 Å for density and refractive index and extended to 2250 Å for the resistance measurements. The deposits were produced by vaporisation of Ni in a high vacuum. The density was obtained by determination of weight and thickness. The weight was measured in the high vacuum directly after the formation of the mirror by means of a null method with a micro-balance. The thicknesses of the layers were obtained by means of an X-ray optical interference method, which gave at the same time the refractive index. The specific resistance was measured in the vacuum without the layers coming into contact with air before the measurement. It was found that the densities on the average are 20–25 % smaller than normal. The dependence of the specific resistance on thickness agreed qualitatively with that found by other observers: its final value with increasing thickness of layer was about 35 times greater than normal. The value of the refraction coefficient δ ($= 1 - n$) was higher than would be expected from the theory of dispersion. Certain values obtained under special conditions showed deviations up to 15 %. Various causes can be assigned for the smaller values of the density. They may be due to a greater lattice constant or a looser crystallite structure. The high δ values were traced to strong air absorption by the layers after their removal from the vacuum. Calculation indicated with two mirrors that 1 air molecule affects 4 to 10 nickel atoms. J. J. S.

4227. K-Emission Spectra of Elements Cr-Cu and Their Compounds. Privault. *Comptes Rendus,* 199. *pp.* 280–281, *July* 23, 1934.—In addition to the K-emission lines β^{1}, β_{1}, β^{11}, β_{5}, β^{111}, three weak lines *a, b, c,* are recorded in the region 1400–2000 X. A Cauchois spectrograph with curved mica crystal was used, and the photographs investigated with a microphotometer. The lines $K_{a,\,b,\,c}$, are found in the spectra of most of the elements from Cr to Cu, and their probable wave-lengths given. Fluorescent Kβ-radiation, emitted by large crystalline specimens of the compounds is found to shew slight differences from the primary Kβ-lines of the elements, single lines sometimes appearing as close doublets. J. E. R. C.

4228. Determination of X-Ray Line Shapes by a Double-Crystal Spectrometer. L. P. Smith. *Phys. Rev.* 46. *pp.* 343–351, *Sept.* 1, 1934.—As a result of a new mathematical analysis of the action of the double crystal spectrometer, a method of using the instrument has been found which makes it possible to determine the spectral energy distribution of an X-ray line and to calibrate the instrument without any previous knowledge of the diffraction patterns of the crystals. AUTHOR.

4229. Natural Widths of the K-Series of W(74). F. K. Richtmyer and S. W. Barnes. *Phys. Rev.* 46. *pp.* 352–356, *Sept.* 1, 1934.—By means of a two-crystal X-ray spectrometer of high resolving power at short wave-length, the full widths at half maximum of the K-series of W(74) have been measured. The observed widths W_O in the (1, + 1) position of the crystals have been corrected to true widths W_T by use of the formula $W_T = W_O - W_R$ where W_R is the width of the rocking curve of the crystals in the (1, − 1) position. It is shown, that in the short wave-length region under consideration the (1, − 1) rocking curves obey the Hoyt equation. By using Weisskopf's equation for the shape of a spectral line, the above correction formula results. The following (corrected) full widths at half maximum (in volts) are obtained: $K\alpha_2$, 43·3; α_1, 43·0; β_3, 50·0; β_1, 48·6; γ_2, 37·0; γ_1, 37·0; δ_2, 34·0; δ_1, 34. AUTHORS.

4230. M-Series Absorption Spectrum of Metallic Bismuth. W. D. Phelps. *Phys. Rev.* 46. *pp.* 357–362, *Sept.* 1, 1934.—With a vacuum spectrometer and sputtered Bi films as absorbers, the five M-absorption edges were obtained. The large discrepancies between computed and observed wave-lengths of Bi M_{IV} and M_V were verified. The M_I, M_{II} and M_{III} discrepancies were found to be of the order of experimental error. To explain the M_{IV} and M_V discrepancies it is assumed that electrons from M_{IV} and M_V levels, in an absorption act, go to virtual lattice levels above the filled conduction, or valence, levels of the crystal for the elements Ta73 to Th90. Data on, and Kronig's theory of, secondary X-ray absorption are shown to support this view. The application of the ordinary X-ray selection rule $\Delta l = \pm 1$, $\Delta j = \pm 1$ or 0 in M absorption, suggested by Siegbahn, is further discussed. That there is a definite selection rule operating in M absorption there is little room to doubt. AUTHOR.

4231. Dependence of Secondary Structure in X-Ray Absorption on Crystal Form. V. P. Barton and G. A. Lindsay. *Phys. Rev.* 46. *pp.* 362–365, *Sept.* 1, 1934.—An examination of the Ca K-absorption edge in the X-ray absorption spectra of different compounds shows clearly that the secondary structure is not the same in different compounds, and is not even the same in the two crystals calcite and aragonite, which are the same chemically, but of different crystalline form. These facts are in accord with Kronig's theory of the secondary structure. In four other crystals, each of which contains two or more metals, the secondary structure was examined to see if it was the same for the two elements in the same crystal. There is a difference for the two elements, which indicates that the crystal form is not the sole factor in determining the secondary structure. AUTHORS.

4232. Interpretation of X-Ray Diffraction Patterns of a Fluid at Various Densities. N. S. Gingrich and B. E. Warren. *Phys. Rev.* 46. *pp.* 248–251, *Aug.* 15, 1934.—It is shown that existing calculations for the intensity of X-rays diffracted by a fluid at various densities can be applied only over a small range of densities, and it is pointed out that this is due to the distribution of atoms about any one atom chosen for the calculation. The distribution is discussed qualitatively for gases and liquids, and a reasonable approximation to the true distribution is assumed. From this a set of intensity *vs.* angle curves are drawn for several densities. These curves are compared with Stewart's experimental curves for ether [see Abstract 4335 (1933)] at various densities. AUTHORS.

4233. Treatment of Crystals for Two-Crystal Spectrometers. K. V. Manning. *Rev. Sci. Instruments*, 5. *pp.* 316–320, *Sept.*, 1934.—Crystals have been prepared for use on the two-crystal spectrometer by grinding and etching the cleavage faces. The widths of rocking curves in the (1, − 1) position have been investigated for different conditions of the surfaces. The etched crystals have been found to give higher resolving power than the original faces. The improvement is greater at short wave-lengths than at the longer. AUTHOR.

See also Abstracts 3972, 3986, 4017, 4072, 4150, 4151, 4170, 4352, 4353.

HEAT.

CALORIMETRY.

4234. Specific Heat of Furan and Ethyl Ether Vapours. W. H. Jennings and M. E. Bixler. *J. Phys. Chem.* 38. *pp.* 747–751, *June*, 1934.—The specific heat of furan vapour at atmospheric pressure was measured in a flow calorimeter at 44·33, 67·71 and 98·99° C., the data fitting the equation : CP (molal) $= 14{\cdot}2341 + 7{\cdot}188 \times 10^{-2}t - 1{\cdot}071 \times 10^{-4}t^2$ (t° C.) Similar data on ethyl ether were found to fit the equation : CP (molal) $= 23{\cdot}3833 + 14{\cdot}71 \times 10^{-2}t - 5{\cdot}929 \times 10^{-4}t^2$ (t° C.) AUTHORS.

4235. Heat of Fusion and Solubility of Naphthalene. H. L. Ward. *J. Phys. Chem.* 38. *pp.* 761–769, *June*, 1934.—Very pure naphthalene having a melting point of 80·25–80·3° C. has been prepared and some interesting phenomena on its freezing have been noted. The latent heat of fusion of this material has been found to be 4495 cal./mol. A reason has been suggested to account for the fact that this value is somewhat lower than the usually accepted value. The ideal solubility of naphthalene has been calculated by a method which takes into account the variation in the latent heat of fusion with the temperature. The results show excellent agreement with previously published data on the solubility of naphthalene in chlorobenzene. AUTHOR.

See also Abstracts 4076, 4135, 4199, 4250, 4260, 4266, 4267.

CONDUCTION.

4236. Norbury Relation with Thermal Resistance of Metals. H. Reddemann. *Ann. d. Physik*, 20. 5. *pp.* 502–512, *Aug.*, 1934.—Reference is made to the fact found by Gruneisen and Goens that when pure metals are deformed or small amounts of impurity are added there is, for a given temperature, an increase of both thermal and electrical resistance and these two increases are proportional. The impurities cause an increased atomic resistance and the increase depends upon the horizontal distance apart of the pure metal and the impurity in the periodic system. The earlier results on Cu, Ag, Au, Al, Pt and Pd alloys at room-temperature and on Cu also at 100° C. were examined. It was found that (1) the constant of the isothermal law is practically independent of the kind of impurity up to a certain value of the specific electric resistance except for Ag, Pd and Pt. Pd ; (2) above this value deviation from linearity occurs for certain impurities but not even at much higher temperatures for others ; (3) in the region of validity it is possible to calculate the thermal from the electric resistance ; and (4) so long as the thermal and electric resistances are proportional the Norbury relation for thermal resistance holds. R. S. R.

4237. Two Problems Arising in Practical Applications of Heat Theory. E. N. Fox. *Phil. Mag.* 18. *pp.* 209–227, *Aug.*, 1934.—A mathematical analysis is given showing that : (*a*) Newton's law may be modified by the addition of certain terms to give the boundary law at a lagged surface, provided the heat capacity of the lagging is small ; (*b*) the one-dimensional solution for heat flow in a medium may be modified in a simple manner to give, as a first approximation, the heat flow in a subsidiary direction provided the average temperature in this direction is known. R. W. P.

4238. Influence of Electric Fields on Heat Transmission through Gases. H. Senftleben. *Phys. Zeits.* 35. *pp.* 661–662, *Aug.* 15, 1934.—It had been stated in an earlier paper [see Abstract 2905 (1932)] that the transmission of heat from a heated wire to a surrounding tube is increased by the application of an electric field between the wire and the tube. The effect was considered to be the outcome of association of the gas molecules by the electric field [see Abstract 644 (1933)]. Subsequently it has been found that for sufficiently large electric fields the heat flow may rise to nearly double its initial value, an increase which cannot be attributed to the heat of association. It is now suggested that the increased heat flow is the result of electrostriction maintained by the convection currents set up by the heated wire. The electrostriction can become very large in the immediate neighbourhood of the wire and owing to the variations in temperature will possess different values above and below the wire. A pressure difference is thus established near the wire in the presence of the electric field which results in the increased heat flow. R. W. P.

See also Abstract 4340.

CONVECTION.

4239. Heat Transfer by Natural Convection from a Plane, Vertical Plate Immersed in Oil. H. H. Lorenz. *Zeits. f. techn. Physik*, 15. 9. *pp.* 362–366, 1934.—Apparatus is described for the measurement of the heat transfer by natural convection from a rectangular plate 12 cm. high and 25 cm. long when suspended vertically in a bath of transformer oil. The temperature distribution in the oil is measured, and a method given for ascertaining the effective oil temperature. It is found that the results for the heat transfer may be represented by $\mathrm{Nu} = 0{\cdot}555\,(\mathrm{Gr} \times \mathrm{Pr})^{0{\cdot}25}$. This is similar to an expression derived theoretically by Schmidt and Beckmann, and previously found to be true for convection in gases, for which the Prandtl number remained practically constant. In the present experiments this factor varied from 442 to 7·55. The boundary layers around the plate for temperature and velocity are observed and discussed. R. W. P.

See also Abstract 4238.

DILATATION.

See Abstract 3995.

MELTING AND BOILING POINTS.

4240. Freezing-Point Measurements. E. Abel, O. Redlich and P. Hersch. *Zeits. f. phys. Chem.* 170. *Abt.A.* 1–2. *pp.* 112–122, 1934.—In this paper the freezing points of aqueous solutions of iodic acid have been measured up to a concentration of 1 mol. per 1000 g. water. Methods have also been developed for the evaluation of the thermodynamic dissociation constant of electrolytes of intermediate strengths from freezing-point and conductivity data. The dissociation of iodic acid is discussed from the above data, the values of the dissociation constant being: $0{\cdot}26_3$ (0° C., from the freezing-point measurements), 0·19 (18° C., from the conductivity data.) These values compare favourably with the result of

Fuoss and Kraus (0·1686 at 25°, from conductivity measurements.) The activity coefficients of iodic acid have been evaluated. H. H. Ho.

See also Abstracts 4020, 4063, 4253, 4267.

TEMPERATURE, MEASUREMENT OF.

4241. Torsion Step-Spring Thermometer. A. Karsten. *Zeits. f. Instrumentenk.* 54. *pp.* 274–277, *Aug.*, 1934.—Reference is made first to difficulties in the use of other types of thermometers and a description is given of earlier bimetallic types and their limitations. The new pattern described consists of more than one bimetallic strip shaped as a spring and the springs arranged coaxially with the changes of length of each spring acting by addition. The system possesses good stability by having a shorter length and errors are reduced to a minimum. It has a high degree of accuracy, long life, small size and heat capacity, and high precision is obtained for the desired temperature range by suitable choice of Fe, Ni and Mo alloys. Diagrams show the bimetallic strip and special types of thermometers. R. S. R.

4242. Automatic Cryostat. A. I. Schattenstein. *Zeits. f. Elektrochem.* 40. *pp.* 653–655, *Sept.*, 1934.—A simple automatic cryostat, capable of very high accuracy of control is described. By means of thermoregulators and relays, stirring and heating, the conditions requisite for cryoscopic measurements were accurately controlled. Solid CO_2 is used as cooling material and only small quantities are required. The apparatus can be used for long continuous measurements and does not require much space. F. J. B.

See also Abstract 4246.

THERMOCHEMISTRY.

4243. Heats of Formation of HCl and Its Dilute Solutions. W. A. Roth and H. Richter. *Zeits. f. phys. Chem.* 170. *Abt.A.* 1–2. *pp.* 123–133, 1934.—The heat of formation of HCl from its elements has been measured at 21° C. in a closed calorimeter in complete absence of O_2, the HCl formed being determined analytically. The value obtained is 21·87 ± 0·02 cal., which agrees well with v. Wartenberg and Hanisch's result [see Abstract 298 (1933)]. Consideration of the available data leads to the value + 21·89 ± 0·02 cal. at 22° C. as the most probable. In presence of excess of chlorine, somewhat higher values are obtained. Measurements have also been made of the heat of solution of HCl in water at high dilutions at 21° C. The results, and those of Wrewsky and Sawaritzky [see Abstract 3080 (1924)] are expressed satisfactorily by $Q = 17{\cdot}78 - 0{\cdot}4514\ m^{0\cdot5}$ cal. for values of m (mols. of HCl per 1000 gm. of water) between 0·006 and 1·0. T. H. P.

4244. Heat of Dissociation of CO and the Electron Affinity of O. W. W. Lozier. *Phys. Rev.* 46. *pp.* 268–276, *Aug.* 15, 1934.—An apparatus previously described [see Abstract 5370 (1933)] has been employed in a study of the dissociation produced by primary electron impact in CO and O_2. The processes studied in O_2 are $O_2^- \rightarrow O^- + O$ at 2.9 V and $O_2^- \rightarrow O^- + O^*$ at 12·0 V with an estimated accuracy of ± 0·2 V. These figures refer to the potential energy of the dissociation products, the normal molecule considered as zero. These results give two values of E_0, the electron affinity of the oxygen atom, both equal to 2·2 ± 0·2 V. The processes studied in CO are $CO^- \rightarrow C + O^-$ at 9·5 V, $CO \rightarrow C^+ + O^-$ at 20·9 V, and $CO^+ \rightarrow C^+ + O$ at 22·8 V, with an estimated accuracy of ± 0·1 V. It is concluded that D(CO) may have one of two possible values, $9{\cdot}6 \pm 0{\cdot}1$ or $11{\cdot}6 \pm 0{\cdot}1$ V. These experiments are unable to decide between the two, but most of the evidence from other sources points to the lower value. If $D(CO) = 9{\cdot}6$ V the possibility of stable excited O^- ions must be admitted. However, if $D(CO) = -11{\cdot}6$ V, these experiments on CO give two values of E_0, 1·9 and 2·1 V. The processes involved in the formation of negative ions by electron impact are discussed. AUTHOR.

4245. Discussion on Energy Distribution in Molecules in Relation to Chemical Reactions. *Roy. Soc., Proc.* 146. *pp.* 239–271, *Sept.* 1, 1934.—A record of a *Discussion* held before the Royal Society on May 10th, 1934. In the opening address **C. N. Hinshelwood** considered independent modes of activation of the molecules taking part in certain reactions; he also referred to a large class of binolecular reactions in solution where the observed rate is as nearly as may be equal to the rate of encounter of the appropriate activated molecules, and to a second class where the reaction velocity is many powers of ten smaller than the activation rate, and which are very sensitive to the catalytic action of solvents indicating the probability of a ternary collision involving a solvent molecule. He suggested that two extreme cases in chemical kinetics should be distinguished; the first where the rate of reaction is primarily determined by the acquisition of the necessary activation energy, and the second where a probability factor independent of temperature is of equal or greater importance. **J. E. Lennard-Jones** dealt with the electronic structure of molecules at some length and considered the effect of solvents on decomposition. **M. Travers** discussed the pyrolysis of acetaldehyde and quoted conclusions which were the reverse of those stated by Hinshelwood, and which were subsequently criticised by the latter. **M. Polanyi** gave an alternative explanation of the Hinshelwood data and **C. Zener** discussed the two distinct factors which might greatly reduce the probability that a molecule should dissociate following collision with a second molecule. **R. G. W. Norrish** touched briefly on the advantages of the photochemical method in studying the energy charges in molecules and **H. W. Thompson** gave an account of the correlation of certain spectroscopic results with the corresponding photochemical data. **E. J. Bowen** developed at length the photo-decomposition of gaseous aldehydes and ketones. **C. J. M. Fletcher** described briefly the experimental results which formed the basis of the association of the energy of activation with different parts of the molecule, for the different activated states which exist for the aldehydes. **E. K. Rideal** discussed the mechanism of the unimolecular reaction, and dealt with the amount of internal energy actually possessed by the molecules at the reacting temperatures, and with the relationships between the structure and the conditions of transmission of this energy. **Ubbelohde** asked a question about thermal activation and remarked about the sort of physical tests used to check the chemical equation, and **Hinshelwood** in reply quoted experiments which seemed to show that substances which form addition compounds with acetaldehyde at low temperatures do not catalyse its decomposition at high temperatures although the latter might be anticipated. H. H. Ho.

4246. Flame Temperatures in Methane-Air Mixtures. W. T. David and J. Jordan. *Phil. Mag.* 18. *pp.* 228–236, *Aug.*, 1934.—Experiments similar to those previously carried out for CO-air mixtures [see Abstract 727 (1934)] are now described for the measurement of the flame temperatures of CH_4-air mixtures of widely varying compositions at densities of 1/3, 1, and 5 atmospheres. The results are similar to those for CO, in that the flame temperature measured in terms of the electrical resistance of a fine Pt-Rh wire is considerably less than the calculated ideal temperature. In the present experiments this difference varies from 250° to 300° C., and is thought to indicate the existence in the flame gases of a latent energy amounting to about 15 % of the heat of combustion. It is noted that flame temperatures measured by the sodium line reversal method are higher than those obtained by the present method, and are further increased when the air is partially replaced by O_2. The temperature of the resistance thermometer is not affected in this way, and it is suggested that flame temperatures measured by the reversal method may be higher than those corresponding to the mean molecular translational energy of the flame gases. R. W. P.

4247. Theory of Flame Propagation. B. Lewis and G. v. Elbe. *J. Chem. Phys.* 2. *pp.* 537–546, *Aug.*, 1934.—A new theory of flame propagation in slow inflammation is proposed which considers that the highly energised atoms or radicals formed in the flame front play a more important rôle than heat conductivity in bringing the unburned gas to the reacting state. A small number of atoms or radicals diffuse over into the unburned phase, there initiating the chemical reaction. The equation, $\mathrm{VN}\,c(u) = \int_{\mathrm{T}u}^{\mathrm{T}b} -\frac{\partial \mathrm{N}c}{\partial t}\frac{dx}{d\mathrm{T}}\,d\mathrm{T}$, is derived, where V is the flame speed which is identical with the volume of unburned gaseous mixture (under initial conditions) entering the reaction zone per sec., $\mathrm{N}c(u)$ is the concentration of combustible gas in mol./cc. in the unburned phase, T*b* and T*u* are temperatures of the completely burned and unburned gases at X*b* and X*u* respectively (the extension of the wave-front). The theory is applied to explosions of O_3 and O_2 mixtures. The calculated velocities are considered to be in satisfactory agreement with the experimental velocities. An Appendix includes a critical analysis of the essential differences between the present and previous theories. H. H. Ho.

4248. Influence of Electric Field Frequency on the Velocity of Combustion of a Gas. A. E. Malinowski, W. S. Rossichin and W. P. Timkowski. *Phys. Zeits. d. Sowjetunion*, 5. 6. *pp.* 902–905, 1934. *In German.*—The influence of alternating fields of frequencies 10^5 to $0 \cdot 8 \times 10^7 \sim$ upon the velocity of propagation of combustion of a mixture of 25 % acetylene and 75 % air has been investigated, and the effect found to decline with the frequency increase so that at $0 \cdot 8 \times 10^7 \sim$ it is only about 0·6 % in a field of 650–700 volt/cm., whereas at $10^5 \sim$ it amounts to 6·7 %. H. H. Ho.

4249. Photography of Flame in Gaseous Explosions. R. P. Fraser. *Phot. J.* 74. *pp.* 388–404 ; *Disc.*, 404–405, *Aug.*, 1934.—After a brief review of researches upon explosions, the author gives a detailed description of Fraser high-speed cameras used for the photographic analysis of rapid explosions. Photographs are included of the initial and predetonation phases of the following explosions and their phenomena : (1) of a $CH_4 + O_2$ explosion ; (2) of compression waves traversing the burning medium ; (3) of waves reflected backwards and forwards within the flame envelope ; (4) of the influence of extraneous shock waves ; (5) of the phenomena of spin in detonation ; (6) of the initiation of detonation in $2H_2 + O_2$ mixture ; (7) of a self-recorded helical track of spin in a $2CO + O_2$ detonation; (8) of the banded appearance of the flame behind the head of detonation; (9) of pressure waves emerging from the mouth of a tube; and (10) of the effect of electric fields upon detonation. Useful supplementary matter was contributed by **O. C. de C. Ellis.** H. H. Ho.

4250. Standard Substances for Bomb Calorimetry. L. J. P. Keffler. *J. Phys. Chem.* 38. *pp.* 717–733, *June,* 1934.—Succinic acid has been shown to fulfil to a high degree all the conditions reasonably required from a calorimetric standard. Even when the values of different observers are considered, there is a better agreement between the modern ones as there is in the case of the other prospective auxiliary standard, namely, salicylic acid: the former is more stable on heating than the latter and much easier to dry without decomposition; further, the purity of succinic acid may always be tested by accurate titration, which is not the case with salicylic acid. In conclusion, the author proposes to adopt succinic acid as a secondary calorimetric standard for bomb calorimetry and to accept for its isothermal heat of combustion at the temperature 20° C. the value 3025 ± 1 cal._{15} (per gm. weighed in vacuo). AUTHOR.

See also Abstracts **3964, 4013, 4262, 4263, 4287.**

THERMODYNAMICS.

4251. Fusion in Relation to a New Equation of State and the Structure of Matter. S. Franchetti. *Accad. Lincei, Atti,* 19. *pp.* 713–718, *May* 20, *and pp.* 800–803, *June* 1, 1934.—The author establishes an equation of state, different from the classical Mie-Grüneisen equation, namely, $p=\alpha(2L/3V) - (\partial\Phi/\partial V)_S$, where p is the external pressure, V the volume, L the total kinetic energy of the particles, Φ the total potential energy and S is the entropy. He then proceeds to apply this equation to the change of state, criticises some current theories of fusion and suggests an alternative theory. A. J. McC.

4252. Theory of Liquids. T. S. Wheeler. *Indian Journ. Phys.* 8. 6. *pp.* 521–536, *June,* 1934.—It is assumed that at temperatures of low vapour pressure near the melting point, the apparent diameter of the molecules of a liquid increases with temperature, so that, on an average, they continue to touch. Thus Edser's calculations for liquids can be extended to thermodynamic properties and expressions found for the internal heat of vaporisation Li, molecular heats of vapours and temperature variation of surface tension γ. The conclusion is that the molecules of non-associated organic liquids attract one another with a force which, varies inversely as the tenth power of the distance. The general parachor law is verified by theory and further it is shown that $(\delta Li/\delta T)_p$ and $(\delta\gamma/\delta T)_p$ need not equal $(\delta Li/\delta T)_v$ and $(\delta\gamma/\delta T)_v$ as hitherto assumed. H. M. B.

4253. Liquid State. H. Kudar. *Phys. Zeits.* 35. *pp.* 560–563, *Aug.* 1, 1934.—A discussion of the inter-relationship of the following magnitudes: (1) the significance of melting-point temperature and heat of fusion, (2) the temperature-gradient of the fluidity, (3) thermal expansion, (4) self-diffusion and conductivity of solid electrolytes. F. I. G. R.

4254. Thermodynamical Theory of the Equation of State. W. Jacyna, S. Derewjankin, A. Obnorsky and T. Parfentjew. *Zeits. f. Physik,* 90. 5–6. *pp.* 331–341, *Aug.* 21, 1934.—General thermodynamic reasoning is employed to investigate the forms which equations of state must take. It is found that deviations from the perfect gas laws may be accounted for by one of two assumptions, *viz.,* an assumption regarding cohesive forces, or else a " volume " hypothesis relating to the state of aggregation ; to assume both is unnecessary. The volume hypothesis method appears to lead to the more interesting results. J. P. A.

4255. Theory of the Equation of State. Part I. G. Schweikert. *Zeits. f. Physik,* 90. 5–6. *pp.* 355–372, *Aug.* 21, 1934.—The equation of state for gases is derived from the hypothesis that the change in velocity of two molecules on collision is not instantaneous, but requires a definite time, during which the molecular kinetic energy is more or less converted to potential energy. The resulting equation, while of the same general form as that of van der Waals, shows that the corrections to the perfect gas laws are functions of the temperature. There is no need to assume an internal pressure. The relations between the various mean molecular velocities, and formulæ for the specific heats are worked out. J. P. A.

4256. Internal Thermodynamics. V. Njegovan. *Acta Physica Polonica,* 2. 4. *pp.* 416–438, 1934. *In German.*—In the expression $CT = \int_0^T CdT + \int_0^C TdC$ where C is the specific heat and T the absolute temperature, $\int_0^T CdT$ is usually considered to measure the increase in internal energy due to rise in temperature. Reasons are given, however, for including the other term, and for regarding CT as the total active internal energy. $\int_0^C TdC$ is a quantity of energy with the characteristics of a latent heat, and has its origin in the thermodynamically undetermined, internal energy-content. It is shown that the omission of this " internal effect " explains apparent deviations from the Nernst theorem. The entropy of the " internal effect " is independent of the state of aggregation of a substance if the temperature remains fixed, and is therefore probably to be associated with the nucleus. The application of the new principle to the calculation of chemical constants is discussed. J. P. A.

4257. Continuous Transition and Critical Point between Two Solid Phases. U. Dehlinger. *Zeits. f. phys. Chem.* 26. *Abt.B.* 4–5. *pp.* 343–352, 1934.—The transition kinetics of solid metallic phases was investigated by the X-ray method. A continuous transition between the different crystal lattices was observed. The question whether these changes are possible in thermodynamic equilibrium is theoretically examined for the cubic-tetragonal change in Au^2Cu. The continuous transition is shown to be a so-called phase change of the second order. F. J. B.

4258. Symbols of Phase Law and Electrochemistry. E. Lange. *Zeits. f. Elektrochem.* 40. *pp.* 655–661, *Sept.*, 1934.—A system of graphic symbols for phase law and electrochemistry is developed. F. J. B.

4259. Thermodynamics of Aqueous Barium Chloride Solutions from E.M.F. Measurements. E. A. Tippetts and R. F. Newton. *Am. Chem. Soc., J.* 56. *pp.* 1675–1680, *Aug.*, 1934.—Using cells of the type Ba (2-phase amalgam) | $BaCl_2$ (*m*) | Hg_2Cl_2 | Hg, e.m.f. measurements have been made at 0, 15, 25, 35 and 45°. A modification of the method of Jones and Dole for the calculation of the constants of the Hückel equation, by the method of least squares, has been developed and applied to the data obtained. Calculations have been made of the activity coefficients, relative partial molal heat contents and heat capacities of barium chloride in aqueous solution. AUTHORS.

4260. Thermodynamic Relations of Glassy and α-Crystalline Glucose. G. S. Parks, L. J. Snyder and F. R. Cattoir. *J. Chem. Phys.* 2. *pp.* 595–598, *Sept.*, 1934.—Although the properties of a glass depend to some extent upon its thermal history, the view is expressed that fairly satisfactory thermodynamic data can be obtained for well-annealed glasses. In the present study the difference between the heat contents of glucose glass and α-crystals has been determined calorimetrically at 20° C. and with the aid of this result the corresponding differences in entropy and free energy have also been computed. The value for this last quantity is $\Delta F^{\circ}_{293} = 1670$ cal. per mol. Solubility measurements have been made for glucose α-crystals and glass in methyl, ethyl and isopropyl alcohols at 20°. The free energy values thereby obtained for the conversion of α-crystals into glassy glucose are in good agreement with the preceding value derived from the thermal data. AUTHORS.

4261. Thermodynamic Functions for a Diatomic Gas. E. E. Witmer. *J. Chem. Phys.* 2. *pp.* 618–619, *Sept.*, 1934.—The case of a diatomic gas whose molecules have a multiplet normal electronic state belonging to Hund's case (*a*) is considered mathematically. If *m* is the multiplicity and D the separation between the successive components of the multiplet, it is found that if the multiplet contributions to the specific heat, entropy, or free energy are plotted against temperature, curves with the same *m*, but different values of D, differ only in their scale along the temperature axis. J. P. A.

4262. Free Energy of Formation of Lead Amalgams. C. S. Hoyt and G. Stegeman. *J. Phys. Chem.* 38. *pp.* 753–759, *June*, 1934.—Concentration cells having pure lead as one pole and lead amalgams of varying concentration as the other have been constructed and their potentials measured. Reproducible potentials are secured with amalgams up to 66 atomic % of lead. The amalgam is saturated at 0·0142 mole fraction at 25·00° C. and all amalgams between that concentration and 0·66 give the same potential. The free energy of formation of amalgams up to a mole fraction of approximately 0·50 have been calculated as well as the activities of lead and mercury in the amalgams. The heat of solution of lead in unsaturated amalgams has been calculated from the temperature coefficient of the e.m.f. AUTHORS.

4263. Piezochemical Equilibria. E. Cohen and K. Piepenbroek. *Zeits. f. phys. Chem.* 170. *Abt.A.* 1–2. *pp.* 145–148, 1934.—This paper deals with the influence of pressure upon affinity, and considers in particular the effect of pressure upon the e.m.f. of the reversible galvanic element: Tl – amalgam | Tl CNS – KCNS | KCl – TlCl | Tl – amalgam, and the chemical affinity of the reaction: $\text{Tl Cl}_{solid} + \text{CNS}^- \rightleftharpoons \text{Tl CNS}_{solid} + \text{Cl}^-$ within a pressure range of 1 to 1500 atmospheres, with the object of testing the Gibbs-Duhem equation. In order to collect the necessary data, measurements were made of the pressure coefficient of the e.m.f. of the above cell, and of the differential volume change which accompanies the reaction. The data indicated the validity of the Gibbs-Duhem equation within experimental error. [See Abstract 1241 (1934).] H. H. Ho.

See also Abstracts 4019, 4020, 4064, 4069, 4155, 4240, 4268, 4271.

VAPOUR PRESSURE.

4264. Vapour Pressures of Aqueous Solutions of the Alkali Halides. A. Lannung. *Zeits. f. phys. Chem.* 170. *Abt.A.* 1–2. *pp.* 134–144, 1934.—The use and calibration of a hot-wire manometer for measuring the vapour pressures of aqueous solutions are described. By its means the vapour pressures of solutions of all the alkali halides except LiF and NaF have been determined at 18° C. over the concentration range 1 mol. per 1000 gm. of water to saturation point. Further, the vapour pressures of the hydrates of alkali halides stable at 18° C. have been measured, and the solubilities of the salts in air-free water at diminished pressure. The results are tabulated. T. H. P.

4265. Vapour Pressure of Binary Systems. Part I. Benzene and Acetic Acid. F. Hovorka and D. Dreisbach. *Am. Chem. Soc., J.* 56. *pp.* 1664–1666, *Aug.,* 1934.—A new method for the study of the total and partial vapour pressures of binary liquid mixtures is described. Total pressures can be readily obtained over a moderate temperature range. The difficulties due to dissolved gases and moisture are eliminated. It has been confirmed that the acetic acid and benzene system is not azeotropic. AUTHORS.

4266. Vapour Pressure and the Heats of Sublimation, of Fusion and of Vaporisation of Solid and Liquid Deuterium. G. N. Lewis and W. T. Hanson, Jr. *Am. Chem. Soc. J.* 56. *pp.* 1687–1690, *Aug.,* 1934.—The vapour pressure of deuterium containing less than 0·03 % hydrogen has been measured between 20 and 15° K. Small amounts of hydrogen produce large changes in the observed vapour pressure. The measurements for the liquid are accurate to 0·1 % and for the solid to 0·1 or 0·2 %, except at the three lowest temperatures. The vapour pressures were compared to those of para-hydrogen and temperatures were thus obtained from an equation of Keesom, Bilj and van der Horst. An equation of state used by Simon and Lange for hydrogen was assumed to apply also to deuterium. Thence the fugacities were determined and from these values the ideal heat of vaporisation of the liquid deuterium 308·3, and of solid deuterium 357·2 cal. per mole. The heat of fusion is therefore 48·9 cal. per mole, and this value is almost independent of the equation of state employed. The vapour pressure of para-hydrogen at its boiling point is three times that of deuterium and is seven times that of deuterium at our lowest temperature. The vapour pressure of liquid deuterium is not observably affected by the presence of charcoal. The triple point of deuterium is 18·66° K., and the boiling point is found by extrapolation to be 23·6° K. AUTHORS.

4267. Vapour Pressures and Derived Thermal Properties of Hydrogen and Deuterium. R. B. Scott, F. G. Brickwedde, H. C. Urey and M. H. Wahl. *J. Chem. Phys.* 2. *pp.* 454–464, *Aug.,* 1934.—The vapour pressure equations of liquid and solid normal D_2 are determined between 13·9° and 20·4° K. by comparison of the vapour pressure of D_2 with that of liquid H_2. The triple and boiling points of D_2 are found to be 18·58° and 23·5° K. respectively. D_2 resembles H_2 in that the vapour pressure over the liquid changes with time owing to conversion from the ortho to the para form, but the rate of conversion is about 1/40th of that of liquid H_2. The latent heats and heat capacities of solid and liquid D_2 at constant pressure are calculated from the vapour pressure data. R.W.P.

4268. Continuation of the Vapour Pressure Curve above the Critical Point. A. Eucken. *Phys. Zeits.* 32. *pp.* 708–711, *Sept.* 1, 1934.—In this critique of the work of Trautz and Ader [see Abstract 2960 (1934)] the author maintains that the possibility of a continuation of the vapour pressure curve beyond the critical point may be demonstrated theoretically. On the question of discontinuities at the critical point, he shows that it remains an open question whether true discontinuities occur there, or only rapid changes. In reply, **M. Trautz** points out that his claim was that no theoretical indication of the form of the vapour pressure curve above the critical point was available. Other criticisms are briefly answered. J. P. A.

See also Abstract **4062.**

ACOUSTICS.

4269. Vibration Figures on Membranes. P. E. Schiller. *Zeits. f. techn. Physik,* 15. 8. *pp.* 294–296, 1934.—An apparatus suitable for the production and demonstration of sand figures on a vibrating membrane, with a wide range of possible variation is described. To generate the vibrations the membrane is connected to the vibrator of a loud-speaker unit. Photographs of sand figures are given. J. P. A.

4270. Air-Column Behaviour in Orchestral Wind Instruments. J. Redfield. *Acoustical Soc. of America, J.* 6. *pp.* 34–36, *July,* 1934.—It is pointed out that there is little agreement between the simple theoretical treatment of a clarinet and the experimentally observed phenomena. The various assumptions used in the theory are examined and certain possible sources of error indicated. J. E. R. C.

4271. Velocity of Propagation of Sound in Carbon Dioxide Near the Critical State. V. Špakovskij. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 3. *pp.* 31–34, *July* 1, 1934. *In English.*—The velocity of propagation of sound in CO_2 gas at temperatures of 15, 20, 30, 31·5, 35, 40 and 50° C. and at various pressures from 1 to 85 atmospheres was measured. The values of the ratio of the thermal capacities at constant pressure and constant volume were calculated, and the causes of the small increase in the molecular thermal capacity at constant volume resulting from the pressure are discussed. J. J. S.

4272. Theory of Reverberation. A. Hirayama. *I.E.E., Japan, J.* 54. *pp.* 565–572, *June,* 1934. *English Abstract.*—The author criticises Eyring's reverberation formula and substitutes for it an equation of the same type, *i.e.,* $T = KV/-S \log (1-a)$, where K now depends upon the shape of the room. By an oscillograph method the reverberation times of rooms with their windows (*a*) closed, and (*b*) open were determined, and by substituting in the above equation, K and *a* were deduced. The author prefers to adopt 0·85 as the absorption coefficient of his windows when the mean value of the constant K for the rooms tested approximated to the 0·163 of Eyring's formula although unrelated to it. E. J. I.

4273. Scale Models for Acoustical Investigations. F. Spandöck. *Ann. d. Physik,* 20. 4. *pp.* 345–360, *July,* 1934.—A method of using scale models of buildings as a means of investigating their acoustical properties is described. Models are built to 1/5 scale, the frequency used for the measurements being 5 × the frequency at which the corresponding measurements are made in the full scale building. The reverberation period of the models is 1/5 that of the building. Two experimental methods are used: (1) to radiate short wave trains periodically from a loud-speaker and to record the intensity variations at a specified point upon a wax cylinder moving at high speed. The record is afterwards examined by running it at 1/5 of this speed. In this way echo formation can be studied; (2) with the loud-speaker radiating a warble tone the intensity is measured at a series of positions by means of a microphone and the uniformity or otherwise of the sound distribution studied. Results obtained in this way upon a model of a rectangular room agree with results obtained upon the room itself. It is pointed out that the shape of the building has its greatest influence when the walls are only moderately absorbent. J. E. R. C.

4274. N.P.L. Acoustics Laboratory. G. W. C. Kaye. *Nature,* 134. *pp.* 202–204, *Aug.* 11, 1934.—A description of the new acoustics laboratory which has recently been erected at the N.P.L. is given. The laboratory contains three specially isolated rooms, one of which is used to measure acoustic absorption coefficients while the other two serve for measurements of sound-transmission factors. Facilities are also available for measurements of the sound arising from impacts, *e.g.,* footsteps. J. E. R. C.

4275. Attributes of Tones. S. S. Stevens. *Nat. Acad. Sci., Proc.* 20. *pp.* 457–459, *July,* 1934.—According to the author the ear can discriminate differences in pitch, loudness, volume and density. Contours of these are given, drawn on axes of frequency and intensity, from the smoothed averages for four observers. On another graph is given the change in pitch of tones of frequencies between 500 and 4000 as a function of the intensity of the tones. Below 3200, the pitch is reduced as the intensity increases, and above 3,200 the opposite takes place. G. E. A.

4276. Definition of Quality in the Male Voice. W. T. Bartholomew. *Acoustical Soc. of America, J.* 6. *pp.* 25–33, *July,* 1934.—The oscillograms of a number of male voices have been analysed and an attempt is made to correlate the physical characteristics of the voices with their quality. Four aspects are examined, the vibrato, the intensity, the low formant and the high formant. It is deduced that a voice, to be of good quality, should have a regular vibrato, a good intensity and well developed high and low formants. The frequency of the high formant is about 2900 ~. This appears to be approximately the same for all singers and is very little affected by the pitch of the note which is sung. It is suggested that the high formant arises from the vibration of the air contained in the larynx. J. E. R. C.

4277. Noise. A. H. Davis. *Engineer,* 158. *pp.* 166–167, *Aug.* 17, *and pp.* 181–183, *Aug.* 24, 1934.—A well ordered summary of the subject under the following headings: (*a*) characteristics, (*b*) physical measurement, (*c*) aural measurement, (*d*) investigation and suppression. E. J. I.

4278. Logarithmic Units: A Need in Acoustics. A. H. Davis. *Phys. Soc., Proc.* 46. *pp.* 631–633, *Sept.* 1, 1934.—In view of the confusion which prevails in the use of logarithmic units, the paper suggests the use of a new unit, to be named the " brig," for the ratio of two quantities, together with certain subsidiary changes, particularly in the nomenclature of acoustics. AUTHOR.

4279. Acoustical Vocabulary. L. Bouthillon. *Soc. Franç Élect., Bull.* 4. *pp.* 671–696, *July,* 1934.—A critique of acoustical terminology from an electrical standpoint, examining in particular the proposals made in the *Rev. d'Acoustique,* Vol. 1, 1932. E. J. I.

4280. Rotating Mirror Oscilloscope. R. F. Mallina. *Acoustical Soc. of America, J.* 6. *pp.* 37–42, *July,* 1934.—The design of the optical equipment of a rotating-mirror oscilloscope is discussed in detail. A design for a robust oscillograph for use with the above is also described. J. E. R. C.

See also Abstracts 4036, 4163.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

See Abstracts **4301, 4302.**

CONDUCTION AND DISCHARGE IN GASES.

4281. Probe Characteristics of Discharges in Gases with High Pressures. K. Sommermeyer. *Zeits. f. Physik*, **90.** 3–4. *pp.* 232–248, *Aug.* 10, 1934.—There is brought out by a calculation the deviations from the Boltzmann distribution of the carriers of charge, which arise with deviations from the static equilibrium position. By its help and with use of a series of assumptions there is given a quantitative demonstration of the probe characteristics at high pressures. Since the Boltzmann formula is valid only with the use of small probe currents there occur with rising probe currents increasing deviations from the straight lines given by the Langmuir and Mott-Smith theory. If the probe characteristics are taken with probes of varying surface the approximate validity of the Boltzmann formula with small probe currents yields not only the asymptotic approximation to the Langmuir–Mott-Smith straight line, but also proportionality of the probe current to the probe surface, and first with higher probe currents may appear with increasing surface of probe increasing deviations from the straight lines. The theory was tested by measurements on the positive neon column and established in the essential points. The electron temperatures obtained from the experimental characteristics are compared with those theoretically following from a consideration of balance of energy. The experimental appear almost twice as great as the theoretical. J. J. S.

4282. Arcs at Atmospheric Pressure. C. G. Suits. *Phys. Rev.* **46.** *pp.* 252–254, *Aug.* 15, 1934.—In the equation for the static characteristic of the electric arc at atmospheric pressure, $E = A + B/I^n$, the exponent n has been interpreted by Nottingham and others as a constant independent of arc length and dependent linearly upon the boiling point of the anode material. This view is criticised from a consideration of new experimental data showing that the spread in measurements of n is necessarily very large. The conclusion that n varies directly as the boiling point of the electrode (anode) material is not given support by these experiments. AUTHOR.

4283. A.C. Resistance Measurements and Plasma Oscillations in D.C. Arcs. E. Gerber. *Ann. d. Physik*, **20.** 5. *pp.* 529–556, *Aug.*, 1934.—Measurements were made by the Hagenbach-Wehrli method of the a.c. resistance of various arcs, using frequencies up to $1\cdot5 \times 10^6$/sec. In general it was found that the a.c. resistance increased with the frequency up to a certain point where it approached constancy. With carbon arcs the constancy of resistance was found at appreciably higher frequencies than were given by Duddell's measurements. In the resistance curves for various arcs saddle-shaped depressions were found. In the case of mercury vapour and tungsten arcs these depressions were found to be due to natural oscillations in the arc plasma. Comparison with the theory of plasma oscillations of Langmuir and Tonks shows that the observed cases cannot be treated as coming under either of the two simple limiting cases: (*a*) electron oscillations independent of ions, or (*b*) ion oscillations independent of electrons. In the cases observed the motions of the ions and electrons affect one another very much and hence data for a quantitative comparison with theory are lacking. A. W.

4284. Pressure of Plasma Electrons and the Force on the Kathode of an Arc. L. Tonks. *Phys. Rev.* 46. *pp.* 278–279, *Aug.* 15, 1934.—It is pointed out that the electrons in a plasma, and particularly in that at the kathode spot of an arc, exert a pressure nkT which has hitherto been overlooked. Numerically, the major portion of the force on the kathode spot can be accounted for in this way. AUTHOR.

4285. Conveyance of Moving Layers in the Positive Column of Rare Gases by Gas Streaming. W. Pupp. *Phys. Zeits.* 35. *pp.* 705–707, *Sept.* 1, 1934.—Experiments are carried out to determine the effect on the velocity of the moving layers in the positive column of the rare gases, when the gas streaming velocity is smaller than the layer velocity. A special electrically operated gas pump which eliminates the use of mercury or oil and uses the rare gas itself as working substance, is devised. Two discharge tubes are connected to the pump; one of them allows a through current of gas to pass, while the other is blocked. Three cases are investigated: (*a*) no streaming, (*b*) streaming from anode to kathode, (*c*) streaming reversed. In all cases the blocked tube shows no change, the layer width remaining at 7·5 cm., and the frequency at 1275 sec.^{-1}. In the other tube, the layer width remained unchanged at 7·65 cm., but the frequencies were 1281, 1291 and 1271 respectively. The layer velocity increased for (*b*) and decreased for (*c*) by 76·5 cm./sec. corresponding to the measured rate of working of the gas pump. The results agree with the simple assumption that the layer velocity is conditioned by the velocity of propagation of the ionisation waves in the neutral gas. If the latter moves, the change in layer velocity is additive. F. C. C.

4286. Asymmetry of Collector Currents. R. D. Rusk and A. L. Peckham. *Phys. Rev.* 46. *pp.* 425–431, *Sept.* 1, 1934.—The two unsymmetrical components of current to a collector in mercury vapour were separately measured from the anode and the kathode directions. A collector taking current from both directions would receive the approximate sum of these unsymmetrical components. Sets of readings at different positions in an arc type of discharge show that both random electron currents and random positive-ion currents are greater to the kathode face of the collector than to the anode face except in a region near the kathode where exactly the reverse is true. Determinations of space potentials and electron energies were not greatly affected by the asymmetry of the currents but determinations of electron concentrations were and the results indicate a region of maximum concentration from which positive ions and electrons may diffuse or drift in both directions. From a consideration of the rate of absorption of the primary beam a value of the mean free path is obtained and the region of maximum ionisation appears at approximately this distance from the kathode. AUTHORS.

4287. Ionisation of Carbon Disulphide by Electron Impact. H. D. Smyth and J. P. Blewett. *Phys. Rev.* 46. *pp.* 276–277, *Aug.* 15, 1934.—The ionisation of CS_2 by electron impact has been studied. It has been found that the CS_2^+, CS^+, S^+ and C^+ ions are produced at 10·4 ± 0·2, 14·7 ± 0·5, 14·0 ± 0·5 and 21·5 ± 1·0 volts, respectively. The absence of S_2^+ ions and the high appearance potential for C^+ indicate a linear molecule. By raising the filament temperature free CS and S_2 are produced and their ionisation determined as 10·6 ± 0·3 and 10·7 ± 0·3 volts. Heats of dissociation for various processes are deduced from the experimental data. **Authors.**

4288. Excitation of Light by Alkali Ions. R. E. Holzer. *Phys. Rev.* 46. *pp.* 280–283, *Aug.* 15, 1934.—Light emission produced by slow alkali ions in the rare gases was observed for ion-accelerating potentials below those necessary to produce ionisation. It was found that light could be observed in helium, neon and argon at the lowest ion-accelerating potential for the particular alkali ion that lay closest to the gas in the periodic table. A sodium ion beam in neon produced light at lower accelerating potentials than those reported for neon ions in neon. **Author.**

4289. Determination of h/m by Velocity and Wave-Length Measurements of Kathode Rays. J. Gnan. *Ann. d. Physik,* 20. 4. *pp.* 361–376, *July,* 1934.—Using Kirchner's suggested method [see Abstract 1721 (1932)] a beam of electrons which has been monochromatised in a magnetic field is passed through two condensers which are subject to an oscillating electric field controlled by a valve oscillator. If the time taken by the electrons to pass from the first condenser to the second is the same as that of a half period of the electrical oscillations, the beam passes on undeflected by the second condenser if it was not initially deflected by the first. The condition for a sharp image is given by $v = 2\nu s/n'\mathrm{C}$, where s is the distance between the condensers and ν the frequency of the electrical oscillations. The wave-length of the electrons is then determined by diffraction at a thin Bi sheet, the final formula being $h/mo = 2d \sin\theta/n \cdot 2\nu s/n'\mathrm{C} \cdot 1/\sqrt{1-\beta^2}$. The direct measurement of a high potential is avoided in this experiment. Bismuth is used as diffracting material since it gives an intense diffraction pattern with a small exposure: the Bi is calibrated simultaneously against the standard NaCl lattice. The various sources of error are discussed in detail and the final value for h/m_0 is $7 \cdot 25 \pm 0 \cdot 03$. Using Kirchner's value $e/m_0 = (1 \cdot 7585 \pm 0 \cdot 0012) \cdot 10^7$, $h/e^{4/3}$ is found to be $(1 \cdot 758 \pm 0 \cdot 006) \cdot 10^{-14}$ a value in good agreement with previous workers, but not sufficiently accurate to discriminate between them. For the same reason the results cannot decide between the values of the fundamental constants as determined from X-ray data and from Millikan's determination of e respectively. F. C. C.

4290. Electron-Optical Current Distribution in Electron Tubes with Control Electrodes. M. Knoll and J. Schloemilch. *Arch. f. Elektrot.* 28. *pp.* 507–516, *Aug.* 18, 1934.—In order to determine whether the current distribution in electron tubes with control electrodes (such as amplifying or transmitting valves) obeys the laws of electron optics, special tubes were built which allowed direct observation to be made of the current distribution, either by means of fluorescence on the anode or by excitation of gas. The observations with these tubes gave the following results: (1) with tubes operated at relatively low potentials the current does not take the form of a continuously flowing electron gas, but of separate rays, which at the anode give rise to a series of typical current distribution pictures; (2) the cross-section and shape of the rays depends in a pronounced manner on the grid- and anode-potential; (3) each of the typical current distribution pictures at the anode can be produced with different grid and anode potentials. For the same anode picture, therefore the same focal length of the electron-optic system of the grid opening, the ratio of the control potential to the anode potential is constant; (4) owing to the anode surrounding the grid it is possible to obtain sharply defined rays which strike the glass walls and with these direct observation may be made of the way in which the secondary electrons generated at the glass walls return to the anode. A. W.

4291. Preparation of Free Hydroxyl. E. M. Stoddart. *Phil. Mag.* 18. *pp.* 409–421, *Sept.*, 1934.—The experiments of Lavin and Stewart on the removal of free OH from a discharge through water vapour have been repeated, but their results and theories are not confirmed. The quenching of the afterglow of O_2 by means of water vapour has been studied, OH being found to be one of the products of the reaction. Glowing O_2 has also been treated with atomic H and H_2, OH again being produced. It has not been possible to separate the OH from atomic H and O.

AUTHOR.

4292. Mode of Operation of the Tube Counter and the Gas-filled Photoelectric Cell. H. Teichmann. *Phys. Zeits.* 35. *pp.* 637–639, *Aug.* 15, 1934.—The similarity of operation of the Geiger-Müller counter and the gas-filled photoelectric cell is discussed; the behaviour of both pieces of apparatus is considered to depend fundamentally on the Townsend glow discharge. F. C. C.

4293. Types of Discharge in Cylindrical Tube Counters. S. Werner. *Zeits. f. Physik*, 90. 5–6. *pp.* 384–402, *Aug.* 21, 1934.—The tube counter exhibits a sequence of types of discharge as follows. Below the threshold potential: the photo-current in a vacuum due to incident radiation and in addition, the gas-amplified photo-current. Above the threshold potential: the corona discharge for small current densities up to the glow discharge for large current densities. The characteristics of the corona discharge fall into two sets, the stable, and below a certain current density, the unstable. In the unstable region the discharge can be stabilised by incident radiation. The counting properties depend on the fact that while at the threshold potential an unstable corona discharge occurs, this becomes stabilised at a certain over-potential. The cessation of the discharge in the unstable region is found to be a statistical phenomenon. The magnitude of the region between unstable and stable corona discharge determines the counting range. A theoretical explanation is given of the dependence on gas pressure of the threshold potential and the gas amplification of the photo-current. F. C. C.

4294. New Impulse Counter. H. Alfvén and P. Ohlin. *Zeits. f. Physik*, 90. 5–6. *pp.* 416–420, *Aug.* 21, 1934.—A new impulse counter using an oscillating valve and a step-like discharge of a condenser, is described. The arrangement is such that the mechanical relay registers every tenth impulse and the instrument is therefore direct reading. The resolving power is greater than 10^{-3} sec. F. C. C.

4295. Technique of the Counter-Controlled Cloud Chamber. P. M. S. Blackett. *Roy. Soc., Proc.* 146. *pp.* 281–299, *Sept.* 1, 1934.—Two types of Geiger-counter-controlled cloud chambers are described, the first of which is subject to a uniform magnetic field of 3000 gauss obtained from a water-cooled air-core solenoid, while the second fits between the pole-pieces of a large electromagnet producing about 10,000 gauss. Since the chambers are operated after the passage of the ionising particle, the tracks formed have a breadth which is calculated from the diffusion of the ions during the time τ from the instant of their formation to the instant of drop formation. The breadth of a track varies as $\tau^{\frac{1}{2}}$. When $\tau = 0{\cdot}1$ sec., tracks are obtained in air at 1·5 atmospheres which are about 3 mm. broad: it is almost impossible to obtain much finer tracks at this pressure, owing to the large forces required to produce the necessary acceleration of the piston. The breadth of tracks, for a given delay τ, is inversely proportional to the pressure. The release mechanism is designed with special care, to reduce to a minimum the time taken to release the valve controlling the expansion. To obtain a quick release, the controlling magnet must be quite small and of small inductance: the piston is made of aluminium and an acceleration of $80g$ is obtained. The tracks are liable to various kinds of distortion which may be of great importance in limiting the accuracy of measurement of the tracks. While measurements of track breadths of cosmic rays in O_2 and H_2 confirm the diffusion theory, with heavily ionising particles the apparent breadth is found to be greater than that of electron tracks. (Photographic breadth depends on the intensity of the light and on the optical arrangement.) Broad tracks sometimes found in cosmic ray photographs are interpreted in view of the present work as due mainly to α-particles from radioactive substances in the walls of the chamber. The observed numbers of tracks of different breadths agree with this assumption and it appears probable that they are not connected with cosmic-ray phenomena. F. C. C.

See also Abstracts **3988, 4193, 4244, 4321, 4351.**

CONDUCTION IN SOLIDS AND LIQUIDS.

4296. Self-Consistent Field of Fock for Electrons in Metals. L. Brillouin. *J. de Physique et le Radium*, 5. *pp.* 413–418, *Aug.*, 1934.—When the Hartree self-consistent field is applied to the case of electrons in an ion lattice, the eigenenergies in the Schrödinger equation involving the self-consistent periodic potential, do not give the energy change when an electron is added to the system unless an important correction is made for the exchange energies. Using the Fock self-consistent field, however, the energy associated with a given electron is obtained directly. Actually the amplified Hartree method and Fock's self-consistent field give much the same general results and differ principally in the numerical calculations involved. W. S. S.

4297. Mean Free Path of Electrons in Bismuth. A. Eucken and F. Förster. *Göttingen Nachrichten* 1. 3. *Fachgruppe* 2. *pp.* 43–54, 1934.—The mean free path of electrons in bismuth is deduced from measurements of the specific resistances of a series of single crystal wires of Bi ranging down to 1·9 μ dia. The measurements were made over the temperature range 93° to 473° K., the value of the mean free path being found to decrease with increase in temperature. The observed change with temperature is in agreement with the classical electronic theory rather than the Fermi-Sommerfeld theory. The number of free electrons per $cm.^3$ is derived, the classical theory again appearing the more appropriate to employ. R. W. P.

4298. Resistance of Liquid Metals. N. F. Mott. *Roy. Soc., Proc.* 146. *pp.* 465–472, *Sept.* 1, 1934.—It is assumed that the atoms in a liquid metal vibrate about slowly varying mean positions with a frequency ν_L; the ratio of ν_L to the atomic frequency of the solid is calculated from the observed latent heat and melting point. It is shown that the change of resistance on melting can be accounted for by the change in atomic frequency, for normal metals; and the bearing of this fact on theories of liquid structure is discussed. [See also Abstract 1688 (1934).] AUTHOR.

4299. Electrical Conductivity of Electronic Semi-Conductors. B. Gudden. *Ergeb. d. exakt. Naturwiss.* 13. *pp.* 223–256, 1934.—This paper is a critical survey of the contributions which have been made to the subject of the electrical conductivity of electronic semi-conductors. It refers to the work of some seventy investigators and contains sections dealing with (1) the question of electronic or ionic conduction; (2) the validity of Ohm's law, and determination of the specific conductivity; (3) the question whether the specific conductivity is a constant of the substance; (4) temperature variation of specific conductivity and its explanation; (5) particular values for the temperature coefficient; (6) effect of light on the conductivity of semi-conductors; (7) chemical structure and electronic conduction, and (8) theory of electronic semi-conductors. It is concluded that there is need for considerably more coordinated experimental and theoretical work on this subject. R. W. P.

4300. Amplification of Galvanometer Deflections. A. V. Hill. *Journ. Sci. Instruments*, 11. *pp.* 281–282, *Sept.*, 1934.—An equation is given for the deflection of a secondary galvanometer coupled to a primary galvanometer with a photo-cell, and it is shown that this type of amplification is greatly superior in speed to amplification with a thermal relay. [See also Abstract 3810 (1934).] AUTHOR.

4301. Barretter for Medium and Low Frequencies. J. Schiele. *Phys. Zeits.* 35. *pp.* 632–633, *Aug.* 15, 1934.—The author first describes a method of preparing barretter resistances. A loop of 4μ Wollaston wire, suitably supported, is immersed in nitric acid a little at a time until the desired resistance is obtained. The process may be hastened by electrolysis. In the second part of the paper, a modified barretter bridge, suitable for low frequencies, is described. Chokes to bar the a.c. from the d.c. circuit are impracticably large, so the bridge arms whose resistances are to be varied by a.c. are themselves bridges, fed across one diagonal by a.c. and the other by d.c. These secondary bridges have resistances of 4μ Wollaston wire of fixed value, and the two units forming the variable axis of the barretter are enclosed in the same evacuated glass tube. The secondary bridges must be precisely balanced. A sensitivity of 10^{-8} ampere was obtained at 8000 $\sim$. L. E.

4302. Measurement of Very High Liquid Resistances. M. Wien. *Phys. Zeits.* 35. *p.* 652, *Aug.* 15, 1934.—Following technique developed by Schiele [see preceding Abstract] the author adapts his original "barretter" method to the measurement of liquid resistances of the order of 10^9 ohms at frequencies ranging from 1500 to 150,000 $\sim$. He acknowledges the existence of an error, introduced by polarisation capacity at the electrodes, in his earlier work on the dielectric constant of liquids, especially when the resistance and the frequency were low. He is still uncertain as to the order of the polarisation capacity in non-aqueous solutions. T. I. J.

4303. Modified H.F. Resistances. P. Wenk. *Phys. Zeits.* 35. *pp.* 653–654, *Aug.* 15, 1934.—A previous paper [see Abstract 1697 (1934)] described resistances formed by sputtering Pt-Ag or Pd-Ag on Calan tubes. These resistances have been found unstable owing to changes between crystalline and amorphous modifications (of very different resistivities) of the metals, due to a slow recovery after sputtering. Heating for a short time to 600–700° C. in the absence of oxygen decreases the resistance considerably to a constant value. Details are given of the permanence of 1 ohm, 100 ohm and 1 megohm. units. The temperature coefficient is of the order of $+ 10^{-4}$ per °C. The copper end-pieces previously used are replaced by silvering, and the loading improved by perforation of the Calan tube. The reactance of the resistances is considered and a constant-inductance plug-box, built up of resistance units and similar copper tubes, is illustrated. W. H. W.

4304. New Comparisons of the National Standards of Electrical Resistance. A. Pérard and M. Romanowski. *Comptes Rendus,* 199. *pp.* 523–526, *Aug.* 27, 1934.—A summary is given of the results of comparisons made between the standards of the ohm of the six great national laboratories represented in the consultative committee for electricity of the International Committee. These comparisons were made in the laboratory of the International Bureau of Weights and Measures and were carried out by the method of Thomson's double bridge, and are intended to give relative values and not absolute magnitudes. The results are given in terms of the average value of the ohm got from the measurements in the six national laboratories. J. J. S.

4305. Influence of Charge on the Resistance of Metallic Films. A. Deubner. *Ann. d. Physik,* 20. 5. *pp.* 449–462, *Aug.*, 1934.—The author describes an a.c. arrangement consisting of a tube generator, amplifier and special vibration galvanometer to measure minute changes of resistance (of the order of 10^{-6} ohm) that may occur on charging a thin metallic film. The metals used are Ag, Au, Cu and Bi. The results show a change of the order of 10^{-4} ohm for an Ag layer of about 40 atoms thick when charged to a potential of 5000 V. Au shows an effect which is about 10 times smaller. No definite change can be established in the cases of Cu and Bi. The results are discussed from the theoretical standpoint and some suggestions of a qualitative nature are put forward, which are in agreement with the experiments, concerning the effect of the charge on the number of electrons present. It is concluded that further experiments are desirable. R. L.

4306. Specific Resistance of Powders. Z. Specht. *Acta Physica Polonica,* 2. 4. *pp.* 393–409, 1934. *In German.*—The resistance R of a column of powdered material at a constant mechanical pressure is not usually proportional to its length l but is given by $R = Al + K$, where A is a function of the specific resistance of the material in bulk, the size of the grains, the contact resistance between the grains, and also that between successive layers of powder, if the column is formed in layers. K is the difference between the electrode contact-resistance, and that between layers, and therefore may be positive or negative. Experimental results for graphite, MnO_2 and PbO_2 are discussed, and the precautions necessary in order to obtain a value for the specific resistance, which shall be characteristic of the material, and not dependent on the electrodes, method of formation, and length of the specimen, are indicated. L. H.

4307. Skin Effect in Rectangular Conductors at High Frequencies. W. Jackson. *Phil. Mag.* 18. *pp.* 433–441, *Sept.*, 1934.—As the frequency of an a.c. flowing through a conductor increases the current tends to be concentrated more and more on the surface until the contour of the cross-section becomes coincident with a stream-line of the magnetic field. The magnetic field distribution is then equivalent to that of the electric field of a charged cylinder of the same shape, current density corresponding to electrostatic surface density. This analogy has been used by Cockcroft to calculate the h.f. resistance of isolated cylindrical conductors of rectangular section. An account of the experimental verification of this theoretical work is given in the present paper. The measurements consisted in determining the effective resistance per unit length of a series of copper conductors of rectangular cross-section, at the same high-frequency, $6 \cdot 67 \times 10^6 \sim$ (45 m.). Each of the several conductors was bent along its width into the form of a large single-turn rectangle and used as the inductive part of a resonant circuit tuned by means of a special low-loss air condenser. The circuit was loosely coupled to an oscillation generator. Details of the arrangement are given, and also the experimental results, from which the conductor resistance per cm. is obtained.

J. J. S.

4308. Rectifying Power and Photoelectric Effect of the Carborundum Detector. P. Specht. *Zeits. f. Physik.* 90. 3–4. *pp.* 145–165, *Aug.* 10, 1934.—Two components of the valve-action of the SiC detector are shown to exist. The first is connected with SiO_2 localised in the blocking layer. This blocking-layer effect is important only at lower current densities. It shows a very good valve-action (ratio of currents in the two directions 1 : 1000) and great dependence on the material of the contact wire. The second component has its origin in the volume of the crystal and governs the valve-action at higher current densities. The volume effect gives relatively poor rectification (ratio of currents 1 : 2) and depends little on the material of the contact wire. The valve-actions of the two effects are opposed, the transition from one to the other occurring smoothly or abruptly according to the nature of the limiting layer. The photoelectric effect depends on the nature of the contact wire in a similar manner. Photo-potentials up to 2 volts in a vacuum were obtained corresponding to a current density of the order of 10^{-9} to 10^{-12} ampere. Patches sensitive photoelectrically showed also good blocking layer valve-action. The photoelectric current is proportional to the light intensity over a very small range: saturation eventually occurs. Maximum current is obtained for normal incidence: the photo-potential increases linearly with rise of temperature. Theoretical considerations of both effects show many similarities with corresponding phenomena for other materials and satisfactory results for the thickness of the limiting layer and for the effective cross-section of the contact point are obtained.

F. C. C.

4309. Crystal Detectors. J. N. Frers. *Zeits. f. Elektrochem.* 40. *pp.* 612–624, *Sept.*, 1934.—The following detector combinations were investigated: Pt/CuBr, Pt/Ag_2S, Pt/Cu_2S, Pt/PbS, Pt/MoS_2, Pt/FeS_2, Pt/ZnO, FeS_2/PbS, ZnO/PtS, ZnO/FeS_2. From the characteristics taken it is shown that a connection exists between the results hitherto obtained from the investigation of the conduction of electricity in solid substances and the mechanism of crystal detectors. A representation of the mechanism of crystal detectors is developed, on the basis of which the detector action of all combinations examined without exception can be explained.

J. J. S.

4310. Metal Current-Carrying Contacts. H. Williams. *Journ. Sci. Instruments,* 11. *pp.* 273–279, *Sept.*, 1934.—Considerable information of a detailed character, bearing upon the construction and the choice of material for electrical contact-making devices, is given covering wear-resisting properties and reliability generally. One table gives the arcing limits of current for a few metals, and a second correlates melting points and life, expressed in terms of the effective number of "makes" and "breaks." The main conclusions reached during the testing of a special type of contact and spring are described. Fault liability is shown to decrease with increase of contact pressure and to be much smaller with twin contacts than with single contacts. Humidity does not, and current conditions only slightly, affect the liability to faults, but sparking reduces it. For all-round reliability, pure twin silver contacts of dome shape are recommended. Where very small voltages are present, platinum should be used. Spring oscillation or any other disturbing influence reacts unfavourably on the reliability of contacts. T. I. J.

4311. Structure Sensitivity of the Low-Temperature Ionic Conductivity of Rock-Salt. M. Kassel. *Zeits. f. Physik*, 90. 5–6. *pp*. 287–311, *Aug*. 21, 1934.—The low temperature (between 20° C. and 500° C.) conductivity of rock-salt crystals from different sources and subject to different thermal and mechanical treatment is determined. Crystals are found which show practically no back potential in the lower half of the temperature range; it is therefore possible to observe the effect of temperature change on the initial conductivity and on the back potential of the constant conductivity. The results are in good agreement with direct measurements of Beran and Quittner [see Abstract 591 (1931)]. At temperatures above 400° C., purification can be effected by electrolysis of the eutectic. Systematic changes in the initial conductivity and the back potential occur as the temperature is raised and the action constant of the van't Hoff formula for the initial conductivity shows a slow increase after a temperature of 600° C. is reached. The effect of plastic deformation on the conductivity was determined by traction experiments between 40° C. and 100° C.; errors due to variations in resistance at the electrode contacts were eliminated. The dependence of the conductivity on the time allows a determination of the "electrical elastic limit" to be made. The conductivity is affected in the same sense by chemical and mechanical inhomogeneity. All the low temperature conductivity of rock-salt is attributed to the number of conduction ions, which in turn is connected with the number of crystal faults. If the wandering of ions along crystal faults is accepted the increase in the action constant of the initial conductivity and the back potential with rise of temperature is due to the increase in the number and uniformity of distribution of faults throughout the crystal. F. C. C.

4312. Mobility of Electrons in Alkali Halide Crystals. A. Smakula. *Göttingen Nachrichten*. 1. 4. *Fachgruppe* 2. *pp*. 55–65, 1934.—The mobility of electrons in several alkali halide crystals is determined in terms of the applied potential, the resulting electric current and the number of optically observed colour centres within the crystal. The values obtained for the potassium salts are some 20 % greater than those recently reported by Stasiw [see Abstract 2726 (1934)]. An empirical equation is given representing the effect of temperature on the electronic mobility, and a connection is obtained between the mobilities of the halide salts of any one metal, and the ratio of the absolute temperature to the characteristic temperature of the particular salt. R. W. P.

4313. Migration Velocity of Electronic Colour Centres in Crystals. J. Frenkel. *Phys. Zeits. d. Sowjetunion*, 5. 6. *pp*. 911–918, 1934. *In German*.—An explanation is given for the formation of colour centres when an electric field is applied to a heated alkali halide crystal. It is considered that the colour centres can be identified with excess alkali metal atoms which form a kind of solid solution of metal in the salt, and arise from the neutralisation of dissociated metal ions by combination with electrons. A simple formula is derived for the migration velocity and by comparison of this formula with the results of Pohl and Stasiw the value of 10^{-4} is obtained for the fraction of electrons in the colour cloud which are actually free electrons. The dispersion of the migration velocities, which occurs at temperatures below the break in the conductivity curve, is explained as being due to the partial crystallising out of the metal atoms in the form of a colloidal solution. R. W. P.

4314. Electric Conductivity of Ag_2HgI_4. J. A. A. Ketelaar. *Zeits. f. phys. Chem.* 26. *Abt.B.* 4–5. *pp.* 327–334, 1934.—The conductivity of both α- and β-modifications of Ag_2HgI_4 (from 18·5 to 93·4°), and transport numbers at 60° (with 10 mA) show, as anticipated [see Abstract 1413 (1934)], that the conductivity of the α-form is strong and purely ionic with low temperature coefficient, being expressible as $Ae^{-B/T}$, where $A = 400$, $B = 4300$, and T is absolute temperature. The current is almost wholly carried by the Ag-ion. The conductivity of the β-form does not follow so simple a law, showing an increasingly rapid variation with temperature from 30° to the transition point, explicable, as also is the gradual change in colour, by gradual change in structure; a similar explanation applies to the slow re-establishment of the β-state on cooling. The low value of the constant B for the α-modification compared with that for other substances showing ionic conductivity (*e.g.* γ-AgI 9550, TlBr 9900) is explained by the unoccupied state of ¼th of the positions in the cubic lattice, ¾ths occupied by the Ag and Hg atoms, which dispenses with the dissociation energy. C. A. S.

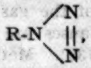
4315. Preparation of Water of Minimum Specific Conductivity. K. Gostkowski. *Zeits. f. phys. Chem.* 170, *Abt.A.* 1–2. *pp.* 149–152, 1934.—The distillation of the water was carried out *in vacuo* in paraffinated apparatus after it had previously been thrice distilled and partially frozen. The best samples obtained possessed a very slight conductivity of the dimensions given by Kohlrausch and Heydweiller. H. H. Ho.

4316. Deviations from Ohm's Law in Weak Electrolytes. L. Onsager. *J. Chem. Phys.* 2. *pp.* 599–615, *Sept.*, 1934.—The effect of an external field on the electrolytic dissociation is computed kinetically from the equations for Brownian motion in the combined Coulomb and external fields. The result is an increase of the dissociation constant by the factor $K(X)/K(o) = F(b) = 1 + b + (1/3)b^2 + \ldots$ where X is the intensity of the field in e.s. units and the parameter b is proportional to the absolute value of the field intensity, and inversely proportional to the dielectric constant. In water at 25° C. $F(b) = F(1) = 2{\cdot}395$ for a field of 723 kV/cm., while in benzene the same increase of the dissociation constant is obtained for a field of only 21 kilovolt/cm. The theory is quantitatively confirmed by the deviations from Ohm's law observed for solutions of weak electrolytes in water and in benzene. The kinetic constants of dissociation and recombination can be computed separately on the assumption that the recombination proceeds as rapidly as the mutual approach of two ions due to the Coulomb attraction. The derivation is equivalent to that of Langevin. The saturation phenomena observed in dielectrics are discussed in relation to the field effect. J. J. S.

4317. Electrical Conductivity of Boron-Trioxide–Sodium Borate Glasses. M. E. Spaght and J. D. Clark. *J. Phys. Chem.* 38. *pp.* 833–838, *June*, 1934.—The electrical conductivities of boron trioxide, sodium borate, and some boron trioxide–sodium borate systems have been measured over a 240° interval with a modified Wheatstone-bridge method. Pure boron trioxide shows a smooth even conductivity curve over the entire measured range, but the mixed glasses gave fairly sharp breaks in the curves in the region of transition of the glasses. These breaks are considered to be associated with the changes in many physical properties in the interval where a viscous liquid changes to a hard glass. The addition of small percentages of sodium borate to pure boron trioxide causes the conductivity to decrease, but further addition causes a steady increase. AUTHORS.

See also Abstracts **4226**, **4236**, **4240**, **4326**, **4339**, **4341**.

DIELECTRICS AND CAPACITANCE.

4318. Dipole Moments. *Faraday Soc., Trans.* 30. *pp.* 679–903, (*with Appendix*), *Sept.*, 1934.—A general survey of the subject comprising 24 papers and general discussion, in which various contributors participated. " Energy Absorption in Dielectrics with Polar Molecules." **P. Debye** (*pp.* 679–684). The rôle of the relaxation time in the " anomalous dispersion " of dielectric constant in liquids is discussed. At relatively low frequencies, the variation is only a second-order effect whereas the energy absorption is a first-order effect. Measurements of energy absorption are described, and the relationship of the results to the predicted values is discussed, the theoretical formula being justified in a qualitative way. The values of the relaxation time deduced (for 3 different polar molecules in 6 different non-polar solvents of varying viscosity) are all of the order of 10^{-12} sec., but they are not proportional to the viscosities of the solvents, which is contrary to expectation if the Stokes formula is applicable. " Temperature Variation of the Dielectric Constant of Ionic Crystals." **E. Bretscher** (*pp.* 684–687). A theory of the temperature variation of the dielectric constant of ionic crystals is developed, but it is not confirmed by the results of measurements on NaCl and CaF_2 crystals. The discrepancy is discussed. " Dielectric Constants of Magnesium and Yttrium Platinocyanide Crystals and the Possibility of Molecular Rotation in Solids." **J. Errera and H. Sack** (*pp.* 687–694). The crystals of these compounds exhibit dispersion, which varies with temperature, along the *c*-axis but not along *a* or *b*, where the moment is small. Measurements show that this dispersion depends on the presence of one or two loosely bound water molecules. This phenomenon is discussed in relation to the corresponding behaviour of ice and the explanations of this given by Pauling and by Debye. It is shown that the results are in harmony with the assumption that the molecules are capable of free rotation in the lattice, and with the Debye model. " Dipole Moment and Cohesion." **A. E. van Arkel** (*pp.* 698–707). A theoretical relationship between boiling point of a liquid and the polarisability of its molecules is deduced, and the values for two series of substituted compounds CX_4 and C_2X_6 are calculated, on the assumption that their molecules are non-polar, in good agreement with the observed values. The theory is extended to polar molecules for which molecular radii are calculated, in agreement with values otherwise deduced. For larger molecules other considerations are involved, but the calculated boiling points are in the right order, and the differences in those of isomers are predicted accurately. " Dielectric Behaviour of Concentrated Solutions of Dipole Substances." **A. E. van Arkel and J. L. Snoek** (*pp.* 707–719). For non-associating liquids such as monohalogenated hydrocarbons, nitro- and nitrate compounds, etc., the polarisation shows a marked decrease with increasing concentration, especially when the dipole moment is large. A modified Debye equation, for non-polar solvents, is deduced to account for this effect, and is shown to agree with experimental data. The theory is also extended to polar solvents and to associating solutes with considerable success. "Dipole Theory and the Size of Molecules." **J. W. Williams** (*pp.* 723–728). A theory is developed, based on the Stokes viscosity formula, of a method of determining the size of spherical molecules from measurements of their dielectric constants in non-polar media at different frequencies, and is discussed in the light of the available experimental data. "Influence of Solvent on Dipole Moments." **F. H. Müller** (*pp.* 729–734). Investigations of the variation of polarisation with solvent suggest that it is only the orientation polarisation which varies. The variation is a regular function of the dielectric constant of the solvents, and an empirical relationship is deduced which permits of extrapolation from the dipole moment measured in solution to that of the gas. Exceptions to this behaviour are observed, and possible causes are discussed. "Atomic Polarisation." **S. Sugden** (*pp.* 734–739). Methods of determining atomic polarisation are discussed. Analysis of available experimental data shows that no clear relationship exists between atomic polarisation and dipole moment, and that P_A values cannot be allotted to groups. In general, the atomic polarisation is always small for organic molecules, and is probably not far different from 10 % of P_E. "Temperature Solution Method and Atom Polarisation." **H. O. Jenkins** (*pp.* 739–745). Methods of determining P_A are reviewed, and an upper limit of 6–7 c.c. for P_A is deduced. It is shown that in consequence of the effect of the dielectric constant of the solvent, in the temperature : solution method the slope of the $P : 1/T$ curve will be too small, so that low values for the electric moment are obtained, leading to high values for P_A. Thus, measurements on nitrobenzene in dekalin solution give a dipole moment which increases with temperature, and a P_A value of 44 c.c. Similar high values recorded in the literature are discussed, and the anomalies are attributed to the existence of the dipole field, producing deviations from the Debye equation in solution. "Dipole Induction Effect and Moments of Individual Bonds." **C. P. Smyth** (*pp.* 752–758). The values attributed to the moments of individual bonds are reviewed in the light of the possibility of induction effects inside the dipoles. It is concluded that the intrinsic moment of the C–H bond is less than $0{\cdot}4 \times 10^{-18}$ (and possibly less than $0{\cdot}2 \times 10^{-18}$), this being the uncertainty in the values for other groups. In many cases, this is less than the moment due to induction or electromeric effects. "Polarity and the Association of Liquids." **A. R. Martin** (*pp.* 759–762). The "restraining force" on polar molecules in a solution increases with concentration, so that the curve of partial vapour pressure against composition becomes concave towards the composition axis. An approximate theory is developed, and compared with the results of measurements on binary mixtures of benzene and its simpler derivatives. "Dipole Association in Pure Liquids." **P. Girard** (*pp.* 763–772). The temperature variation of the dielectric constants of tertiary alcohols shows that they form non-polar association complexes, the extent of association increasing with the number of C-atoms in the molecule. Discontinuities in the dispersion and absorption curves of the polyhydric alcohols, which tend to disappear with rising temperature, indicate polar complexes. At long wave-lengths, the polyhydric alcohols C_2 to C_7 have the same dielectric constant at a given temperature, irrespective of association. This implies a relationship $\mu = \mu_1 \sqrt{n}$, where μ is the moment of the molecule, μ_1 the elementary moment per alcoholic grouping, and n the number of such groups. A similar formula also holds for association complexes of polar molecules. " Dipole Moment and Ionic Binding." **W. H. Rodebush.** (*pp.* 778–786). A discussion of the relationship between dipole moment and type of chemical bond. " Electric Dipole Moments and Resonance in Molecules." **L. E. Sutton** (*pp.* 789–801). The phenomenon of resonance in molecules is discussed, and it is shown that it is possible, from electric dipole moment data, to decide independently whether there is resonance in a given molecule or not, and also to obtain an idea of the more important parent structures and of their relative importance. " Structure of the Organic Azides." **N. V. Sidgwick** (*pp.* 801–804). The moment of the C-N$_3$ group is about $1\cdot5 \times 10^{-8}$, with the negative end remote from the carbon. This is only compatible with the ring formula , but this is definitely excluded by the heat of formation. It is concluded that an organic azide is a tautomeric mixture of two open chain structures, $\mathrm{R\text{-}N = N \mathrel{\overset{\rightharpoonup}{-}} N}$ and $\mathrm{R\text{-}N \leftarrow N \equiv N}$, with a time of change less than 10^{-8} and greater than 10^{-15} sec. " Free Rotation and the Electric Moment of Organic Molecules." **C. T. Zahn** (*pp.* 804–820). The effect on its dipole moment of free rotation about more than one linkage in a molecule is discussed with reference to a number of typical examples. The conception of resonance leads to considerable modification of earlier ideas on free rotation, and this is illustrated by a further series of cases of special interest. " Determination of Intra-Molecular Forces from Measurements of Dipole Moments." **J. E. Lennard-Jones, and H. H. M. Pike** (*pp.* 830–851). The possibility of determining the interaction of polar groups in certain molecules from a study of their dipole moments is investigated, and a theoretical relationship between this interaction and the temperature dependence of the effective dipole of a molecule is provided, with a view to determining the magnitude of the forces between the groups. The case of a molecule containing two similar polar groups, each of which is free to rotate round the axis of the molecule except for the constraint imposed on it by the other group is considered, the mean value of the internal moment of such a molecule relative to axes fixed within it being calculated. The effect of an electric field on an assembly of such molecules is then considered, and the mean moment relative to an axis fixed outside the molecule is found. The results are applied to an analysis of the movements possible inside molecules of the dichlorethane type, and reasonable agreement between theory and experiment is found. " Valency Angles of Oxygen and Sulphur." **G. M. Bennett** (*pp.* 853–858). The valency angle of oxygen, calculated from the dipole moments of ethylene oxide and dimethyl ether, is 115° ± 7°. The value of 140° obtained by analysis of the moments of substituted aromatic ethers is shown to be invalid. The dipole moment of thianthrene indicates that the valency angle of sulphur is less than 120°. " Dipole Moments of the Halogen Hydrides in Solution." **F. Fairbrother** (*pp.* 862–870). The results of measurements of the dipole moments of HCl, HBr and HI in benzene and CCl$_4$ solutions show that the moment in solution is greater than that in the gaseous state. This increase is attributed to a transition of the molecules from a state which is essentially covalent to one which is essentially ionic, under the polarising influence of the dipoles induced in the solvent molecules by the fields of the solute dipoles. "Electric Moment Measurements of Cyclohexane Derivatives and their Relationship to Conclusions Drawn from X-Ray Crystallographic Work." **O. Hassel** (*pp.* 874–876). In agreement with the results of X-ray analyses, the dipole moments of dihalogen derivatives of cyclohexane suggest that their molecules (in solution) are in the high-symmetric *trans* form. "Stereochemistry of Mercury and the Moment of the Hg-C Bond." **G. C. Hampson** (*pp.* 877–883). The dipole moments of mercury diphenyl and its p-derivatives have been measured. They are small, but probably real, and it is suggested that they are due to flexibility of the Hg-C link. The moment of this link is small, with the negative pole towards the Hg. "Polarisation of Chloroderivatives of Diphenyl and Naphthalene." **A. Weissberger, R. Sängewald and G. C. Hampson** (*pp.* 884–891). Results of measurements of the dipole moments of the dichloronaphthalenes are recorded, and discussed in relation to those of the substituted diphenyls. The naphthalene system is shown to be planar. "Dielectric Capacity of Albumin Solutions." **W. J. Shutt** (*pp.* 893–897). The dielectric constants of aqueous solutions of albumin of varying concentration, and the effect on them of variations in pH, are investigated by a modified Fürth method. The results are discussed. "Structure of H_2O_2 and H_4N_2 with Particular Reference to Electric Moments and Free Rotation." **W. G. Penney and G. B. B. M. Sutherland** (*pp.* 898–902). By an application of the electron-pair method it is shown that the most stable configurations of H_2O_2 and H_4N_2 are very unsymmetrical, and that their large electric moments arise from this lack of symmetry rather than from free rotation. The skew structures now attributed to these molecules are in accordance with the Raman spectrum data. The *Appendix*, a table of dipole moments, (*pp.* i–lxxxvi) contains a very comprehensive catalogue of dipole moment data. C. B. A.

4319. Influence of the Electric Field upon Alkali Atomic Rays. H. Scheffers and J. Stark. *Phys. Zeits.* 35. *pp.* 625–627, *Aug.* 15, 1934.—A previously described apparatus [see Abstract 3007 (1934)] is used for an investigation of alkali atomic rays in electric fields and data are obtained which show that a moment is produced in the atoms proportional to the field strength. The proportionality constants for Cs, K and Li are $4 \cdot 2 \times 10^{-23}$, $3 \cdot 4 \times 10^{-23}$, and $1 \cdot 2 \times 10^{-23}$ respectively, with an error of about 5 %. H. H. Ho.

4320. Dipole Moments of Phosgene, Hydrogen Cyanide and Substituted Methanes. C. P. Smyth and K. B. McAlpine. *Am. Chem. Soc., J.* 56. *pp.* 1697–1700, *Aug.*, 1934.—The dielectric constants of the vapours of phosgene, hydrogen cyanide, nitromethane and chloropicrin have been measured and used to calculate the dipole moments of the molecules of these substances. The values thus obtained, together with the moments of other similar molecules, are found to conform closely to the moments calculated on the assumption of a central tetrahedral carbon atom. AUTHORS.

4321. Dielectric Constant of Helium. F. J. Wiśniewski. *Acta Physica Polonica*, 2. 4. *pp* 383–391, 1934. *In French.*—In the first part of the paper, the dielectric constant of He is calculated by applying the principles of generalised mechanics on the Bohr model. The calculated value is in good agreement with experiment. The second part deals with the application of the scheme of corpuscular mechanics previously outlined by the author [see Abstract 1753 (1933)] to the calculation of the ionisation potentials of Be, B, B I, C I, C II, N II, N III, O III and O IV. E. R.

4322. Constancy of the Polarisation of Non-Polar Molecules. C. P. Smyth and K. B. McAlpine. *J. Chem. Phys.* 2. *pp.* 571–573, *Sept.*, 1934.—The dielectric constants of the vapours of *n*-hexane and *n*-heptane are measured over a range of temperature and used to show that the molecules of these substances have no detectable dipole moments. The constancy of the polarisations of non-polar vapours in contrast to the slight rise with temperature of the polarisations of the same substances in the liquid state is attributed to the elimination of the intermolecular action which lowers slightly the polarisability of the molecules in the liquid state. AUTHORS.

4323. H.F. Dielectric Constants of Dilute Aqueous Solutions of Electrolytes. F. P. Henninger. *Ann. d. Physik*, 20. 4. *pp.* 413–440, *July*, 1934.—An experimental method and apparatus is described in detail for the observation of the interaction of a transmitter and a tuned circuit. The reaction of the tuned circuit on the transmitter is first studied by observation of the d.c. anode current flowing in the transmitter. The closeness of the coupling is estimated from a knowledge of the anode current and the nature of the resonance curve. Further, the form of the resonance curve is studied with respect to the closeness of the coupling. The oscillations of the transmitter, in complete resonance with the tuned circuit are analysed with a third very loosely coupled system (Lecher system). In order to eliminate errors from the measurements of the dielectric constants of the conducting solutions the dielectric constant of an aqueous solution of an electrolyte is always measured against the dielectric constant of a KCl solution of equal conductivity. The effect of the change of wave-length with time of the transmitter is eliminated by including measurements on the solution under observation between two measurements on the KCl solution of equal conductivity. Solutions of $CuSO_4$, $La(NO_3)_3$ and $K_4Fe(CN)_6$ are investigated in five different concentrations at one frequency selected so that the measurements are made in the region of the maximum change of dielectric constant with wave-length. The observed results are given in tables and graphs and show good agreement with the theory of Debye and Falkenhagen.

R. L.

4324. Effect of Solvent upon the Moment of a Molecule Containing Movable Dipoles. A. E. Stearn and C. P. Smyth. *Am. Chem. Soc., J.* 56. *pp.* 1667–1668, *Aug.*, 1934.—The dipole moment of ethylene chloride has been determined over a range of temperature in solution in heptane, benzene, CS_2, CCl_4, chloroform and ether, and in certain binary mixtures of these solvents. The measurements point to the formation of a complex between ethylene chloride and ether and are best explained in the case of the benzene solutions by the supposition of an easily dissociated complex between solute and solvent. The conclusion is drawn that a dipole well in the interior of a molecule may have no detectable effect upon the internal potential energies of adjacent molecules, although the molecular field may alter the moment of an adjacent ethylene chloride molecule. AUTHORS.

4325. Electric Moments of Fatty Acids. C. J. Wilson and H. H. Wenzke. *J. Chem. Phys.* 2. *pp.* 546–547, *Aug.*, 1934.—It is pointed out that measurements of the moments of fatty acids from determinations of dielectric constants and densities in benzene solution have no significance as applied to the single molecules, since fatty acids exist as double molecules when dissolved in hydrocarbons. In this paper measurements are recorded for formic, acetic and propionic acids dissolved in dioxane for the purpose of making comparisons with the values for the gaseous substances. Data are also given for stearic acid to determine the effect of greatly increasing the length of the hydrocarbon chain. The polarisations at infinite dilution were calculated by the method of Hedestrand [see Abstract 2589 (1929)]. The moments of acetic and propionic acids are found to be the same in the gaseous state as in dioxane solution, while the moments of stearic and acetic acids are identical. The replacement of the hydrogen of formic acid by an alkyl group results in a considerable reduction of the moment, and the higher electric moment of formic acid appears to be related to its higher ionisation constant. It is suggested that the O-H linkage is more polar in formic acid than it is in the higher fatty acids. H. H. Ho.

4326. H.F. Measurements of Primary Alcohols. K. Krause. *Phys. Zeits.* 35. *pp.* 684–691, *Sept.* 1, 1934.—Two similar double-walled glass vessels have annular air-filled spaces connected by a capillary tube. The movement of a drop of liquid in the capillary indicates a difference of temperature between the vessels. If the two contain equal amounts of the test liquid, and one is subjected to a h.f. field, the power absorbed may be measured by equal heating of the other by d.c., so giving the absorption. Dispersion is measured by a Lecher wire method. Results are reported for alcohols, showing evidence of dipoles, and of oils, showing their absence. Butyl-alcohol is dissolved in varying concentration in three non-polar liquids, of viscosity greater than, equal to, and less than that of the alcohol. Results agree with Debye's theory in that with increasing viscosity the frequency of maximum loss decreases. The range of wavelength is from 2 m. to 6 m. W. H. W.

4327. H.F. Capacitance Measurement. Marie Marketu. *Phys. Zeits.* 35. *pp.* 629–632, *Aug.* 15, 1934.—After some discussion of the relations between circuit conditions and anode current in an oscillator, a simple tuned anode oscillator is described, in which increase of anode capacitance causes a linear decrease of anode current. A sufficiently sensitive anode milliammeter makes possible the measurement of a capacitance of 500 $\mu\mu$F to 1 part in 2000, by comparison with a standard condenser. L. E.

See also Abstracts 3991, 4103, 4238, 4248, 4302, 4316, 4359.

ELECTROCHEMISTRY.

4328. Passage of Current in Electrolytes without Electrolysis. V. Karpen. *Comptes Rendus,* 199. *pp.* 480–483, *Aug.* 20, 1934.—The ordinary laws of electrolysis do not hold when the electrolyte dissolves one of the products of its decomposition by the current. A solution of KI and I can be traversed by a current without decomposition and under a tension as feeble as desired ; the permanent current as well as the corresponding e.m.f. of polarisation depending upon the concentration of I in the solution. Examples are given of the e.m.f. of polarisation for different permanent currents traversing a voltameter containing a solution of KI and I. The currents corresponding to the same e.m.f. of polarisation are incomparably greater when the solution of KI contains I. The atoms of I in contact with the kathode receive an electron and become ions (I –) which under the influence of the field travel towards the anode where, losing the electron, they again become atoms of I. The concentration of I increases at the anode and diminishes at the kathode, thus causing the e.m.f. of polarisation. To the electric current due to the motion of the ions of I from the kathode towards the anode corresponds in a contrary sense a current of atoms of I due to the diffusion of these. Negative electricity alone is thus carried by convection from the kathode to the anode. J. J. S.

4329. Variation of Electrode Potential of Nickel with Acidity. L. Colombier. *Comptes Rendus*, 199. *pp*. 408–409, *Aug*. 6, 1934.—The potentials of electrolytic Ni, prepared without exposure to the air and freed from H by heating *in vacuo* at 500°, in electrolytes of N-$NiSO_4$ with increasing amounts of H_2SO_4 are plotted against the pH of the electrolyte. The potential is independent of the acidity until it is equal to that of the H electrode in the same electrolyte, *i.e.* for pH $>$ 4. As the pH decreases the potential rises (*i.e.* becomes less negative), and the curve is almost || to that of the H electrode, indicating approximately for $\rightarrow 0{\cdot}06$V for pH 0. With Ni not heated *in vacuo* results are similar except that the potential is higher (less negative) throughout. [See Abstract 3893 (1934).] C. A. S.

4330. Velocity of Establishment of Electrode Potential. J. J. Bikerman. *Comptes Rendus*, 199. *pp*. 453–455, *Aug*. 13, 1934.—It is shown that except for very small p.d. the accumulation of ions takes place as quickly as, or more quickly than, the orientation of the dipoles, and consequently that the anomalies in electrode capacity observed with a.c. are not explicable by a retardation in the formation of the double layer. They may therefore be due to change in the dielectric constant and viscosity in the electrolyte-electrode surface. [See Abstracts 4692 (1932) and 3402 (1934).] C. A. S.

4331. Periodic Variation of the Potential of Iron in Chromic-Sulphuric Acid Solutions. Part II. M. Karschulin. *Zeits. f. Elektrochem.* 40. *pp*. 559–564, *Aug.*, 1934.—Additions of a mixture of $CrO_3 - H_2SO_4$ to solutions in which iron had assumed a constant potential either accelerated the solution of the iron or retarded it, owing to the alternations of the iron potential. The data obtained by the observations rendered it possible to explain the positive potential alternations of electrolytic iron. [For Part I see Abstract 2174 (1934).] F. J. B.

4332. Substitute for Platinum Anodes in Electrolytic Oxidation. Part I. Gösta Angel. *Zeits. f. Elektrochem.* 40. *pp*. 641–647, *Sept.*, 1934. —The possibility of using W and Mo electrodes instead of Pt was investigated for the electrolytic preparation of perchlorates, persulphates, perborates and similar oxidation products. It was found that both W and Mo anodes were strongly corroded and that the amount dissolved depended upon the applied voltage and the previous treatment of the anodes. Both metals exhibited valve action due to the formation of a protective oxide layer. Contrary to statements in the literature W and Mo do not form insoluble anodes, but the presence of Pt, in contact with the metals and the electrolyte, caused a difference in behaviour of the W and Mo anodes. F. J. B.

See also Abstracts 3983, 3984, 4078, 4130, 4162, 4258, 4316.

ELECTRONS, POSITRONS AND PROTONS.

4333. Dirac's Theory of the Positron. W. Heisenberg. *Zeits. f. Physik*, 90. 3–4. *pp*. 209–231, *Aug*. 10, 1934.—Dirac's theory of the positron is formulated in terms of quantum electrodynamics. The following are dealt with : the theory of matter waves, including the unhomogeneous differential equation of the density matrix, principles of conservation, and applications (polarisation of the vacuum). Establishment of the fundamental equations, and applications, are also given. J. J. S.

4334. Photographic Investigations on the Positron. L. Bewilogua and K. R. Dixit. *Phys. Zeits.* 35. 699–702, *Sept.* 1, 1934.—Using a uniform magnetic field of 2000–3000 gauss extending over an area of 50 sq. cm., the properties of the electrons and positrons emitted from metal foils when submitted to γ-rays from $9^{mg}\cdot RaBr_2$ are investigated by the method of semi-circular magnetic focussing. Exposures of about 2 hours were given and although the photographic film was shielded by 2·5 cm. of Pb from the direct action of the γ-rays, a correction was necessary for the blackening which they produced. The ratio of the yields of positrons to electrons are : — for Pb 0·185 ± 0·02, for Ag 0·10 ± 0·01 and for Al 0·015 ± 0·005 ; the values are all independent of the foil thickness and proportional to the atomic number. These results are for positrons and electrons of the same kinetic energy and the same angular distribution. In further experiments, the absorption of the corpuscles in foils of Pb and Ag, placed 1 mm. from the photographic film is determined. Curves of the blackening intensity transmitted against the thickness in gm./sq. cm., show an initial rapid steady fall which flattens out sharply at an absorption of about 0·3 gm./sq. cm. of Pb for both positrons and electrons. The sharp bend of the curve marks the complete absorption of the corpuscles, the flatter portion being due to the secondary radiations produced in the absorbing foil. The yield of secondary radiation is about three times greater for positrons than for electrons ; the energy of the quanta (about 0·5M.V.) correspond in both cases to the annihilation of the elementary particles. F. C. C.

4335. Magnetic Electrons. R. Zaïcoff. *J. de Physique et le Radium*, 5. *pp.* 431–435, *Aug.*, 1934.—From the Dirac equations a vector theory is developed establishing the existence of four different types of electrons of positive mass. The Whittaker tensorial equations lead to equations analogous to those of Dirac for each of the four electron types, and it is shown that the total charge-current can be represented as the sum of a vector and the divergence of a tensor. Finally, the vector of the total magnetic state and the density of the proper mass are deduced. N. M. B.

4336. Polarisation of Electrons in a Magnetic Field. E. Rupp. *Zeits. f. Physik*, 90. 3–4. *pp.* 166–176, *Aug.* 10, 1934.—Polarisation of electrons by double reflection at 90° from thin Au foils was effected and the analyser was rotated, the electron distribution at different azimuthal angles being registered photographically. With electrons of 250 kV energy, a 10 % polarisation was obtained. If a longitudinal magnetic field (of 280 gauss) was applied a rotation of the polarisation maximum in the azimuthal plane was observed. With a transverse magnetic field parellel to the plane of incidence, the maximum was rotated out of the azimuthal plane. The results agree with the theoretical prediction that for a tranverse field of 440 gauss all asymmetry disappears in the azimuthal plane, while for 880 gauss the positions of the maxima and minima are interchanged with their positions for zero field. The calculations are based on the special theory of relativity and are unique in involving the factor

$(1-\beta^2)$, where β is the ratio of the velocity of the electrons to that of light, most other experiments depending on $(1-\beta^2)^{1/2}$. F. C. C.

4337. Scattering of Fast Electrons According to Dirac's Theory. J. Meixner. *Zeits. f. Physik*, 90. 5–6. *pp.* 312–318, *Aug.* 21, 1934.—An approximate calculation of the relativistic wave-function in coordinate space for the scattering of a plane electron wave by an atomic nucleus, is carried out. The results contain the formula already obtained by Mott. [See Abstract 3254 (1929).] F. C. C.

4338. Structure of Thin Celluloid Films. Part III. E. T. Jones. *Phil. Mag.* 18. *pp.* 291–302, *Aug.*, 1934.—A further discussion [see Abstract 358 (1934)] of the structure of thin celluloid films. The patterns usually obtained are composed of two, three or more of the simple forms called the principal and secondary patterns. As explained in the earlier papers, the secondary patterns are ascribed to rays which have been twice scattered owing to a double layer in the film. The present paper is concerned with discussion of the probable relative orientation of the lattices of which the double layer is composed. To determine completely the form and dimensions of the lattice itself involves an assumption about the arrangement of the molecular chains, the rings in which constitute the scattering points. The most likely value of the average density of the film is taken as a guide, although the author considers that the composition of the celluloid, and thus the density of the film, may vary from ring to ring. J. E. R. C.

See also Abstracts **4011, 4012, 4054, 4144, 4289, 4293 4297, 4312, 4313.**

ELECTROSTATICS.

4339. Electrostatic Voltmeter for Very High Frequencies. B. A. Sharpe. *Journ. Sci. Instruments*, 11. *pp.* 284–287, *Sept.*, 1934.—The paper describes the construction of an electrostatic voltmeter for use at frequencies up to 10^7 cycles per second. It is a reflecting instrument of low capacity. Its calibration curve is a straight line, in the working range. AUTHOR.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

4340. Change of the Thermal and Electrical Conductivity of a Single Crystal of Bismuth in the Magnetic Field. H. Reddemann. *Ann. d. Physik*, 20.4 . *pp.* 441–448, *July* ,1934.—The electrical and thermal conductivity of a single crystal of bismuth were measured with and without a transversal magnetic field. The measurements without magnetic field gave at − 193° C. for the Wiedemann-Franz-Lorenz number the high value $L = 10{\cdot}9 \times 10^{-8}$, where $L = \lambda/T\kappa$, λ = thermal conductivity, κ = electrical conductivity, and T = absolute temperature. This may be explained on the supposition that the lattice conduction has a real share in the total conduction. The results of the measurements with certain assumptions indicate that the thermal conductivity may be influenced by a magnetic field. J. J. S.

4341. Change of the Resistance of Alkali Metals in a Magnetic Field. M. Koretz. *Phys. Zeits. d. Sowjetunion*, 5. 6. *pp.* 877–886, 1934. *In English.*—In view of the varying results obtained which do not agree with experimental values the author has calculated the change of resistance of metals in a magnetic field for the one case where the theory can give numerical results which do not contain arbitrary constants., that is, for the case of almost free electrons investigated by Nordheim. Following throughout Nordheim's method, and taking into account the dependence of the mean free path of the electron upon its velocity, results more nearly agreeing with experiment are obtained for alkali metals. The change in resistance in a magnetic field cannot be explained on the basis of the Bloch model but must be sought in a more exact theory accounting for the interaction forces between the conduction electrons. J. J. S.

4342. Magneto-Caloric Effect and Other Magnetic Phenomena in Iron. H. H. Potter. *Roy. Soc., Proc.* 146. *pp*. 362–387, *Sept*. 1, 1934. Various magnetic phenomena in iron, as above, have been examined near the Curie point. The experimental method used in the magnetic intensity experiments, capable of accuracy to 1 in 1000, is based on the Kapitza-Webster method for diamagnetic susceptibility and Sucksmith's method for paramagnetic susceptibility. The Weiss theory considers the intramolecular field factor (N) as independent of σ or T, but in the neighbourhood of the Curie point, the present work shows that, whilst independent of σ, (N) shows a rapid increase with increasing T, even to treble its value in a range of 60° C. To explain either the magneto-caloric effect or the magneton numbers in terms of the Weiss theory it must be assumed that $n/q\mu^2$ increases as the temperature is raised above the Curie temperature. [μ is the magnetic moment of the elementary magnets, q is the number per atom and n a factor dependent upon the quantum number j. For Fe and Ni the same variation explains both the magneto-caloric effect and the magneton numbers. The curvature of the $(1/\chi\ T)$ curve just above the Curie point is attributed to variation in N. Magnetisation curves for five samples of iron are given, *viz*., Armco, Hilger Spectroscopic, Heraeus electrolytic, large grain impure iron, and Edwards and Pfeil single crystal. The curves are given as a function of the reduced temperature T/θ. The results for the five samples fit on to the same curve, which showed considerable divergence from the Weiss theoretical curve for $j = \frac{1}{2}$. Full experimental details are given. S. G. B.

MAGNETISM AND ELECTROMAGNETISM.

4343. Temperature Variation of the Structural Demagnetising Factor in Ni and Co. T. Kahan. *Comptes Rendus*, 199. *pp*. 349–351, *July* 30, 1934.—The demagnetising factor of a cylinder may be calculated from its geometrical shape; it is independent of temperature. It is shown that this factor, measured magnetometrically, decreases slightly for Ni and Co cylinders of dimension ratio 100 or greater as the temperature is increased. A structural demagnetising factor is proposed which measures the difference between the total demagnetising factor and that calculated from the geometrical shape of the specimen. H. J. H. S.

4344. Drift of Magnetic Permeability at Low Inductions After Demagnetisation. R. L. Sanford. *Bureau of Standards, J. of Research*. 13. *pp*. 371–376, *Sept*., 1934.—The magnetic permeability of ferromagnetic materials at low values of induction depends upon the time which elapses between demagnetisation and testing. The change may be of the order of 10 or 12 %. In order to obtain consistent and reproducible results in testing at low inductions, a period of from 18 to 24 hours should elapse after demagnetisation before the test is made. **Author.**

4345. Paramagnetic Properties of Divalent Chromium Salts. E. Lips. *Helv. Phys. Acta,* 7. 6. *pp.* 537–583, 1934. *In German.*—The paper opens with the classical and quantum theories of the magneton. The susceptibilities of the chromium salts $CrSO_4 \cdot 6H_2O$ and $CrCl_2$ were measured by the Faraday method for the temperature range 54°–400° K. The sulphate follows the Curie-Weiss law over the given range, and the number of magnetons, namely 4·82 Bohr units, is in good agreement with the Bose-Stoner spin value $\sqrt{4S(S+1)} = 4 \cdot 90$. $CrCl_2$ deviates from the Curie-Weiss law, and the graph of $1/\chi_m$ with temperature is slightly convex to the temperature axis, and does not pass through the origin. G. E. A.

4346. Relation of Dia- and Paramagnetism of an Electron Gas as a Function of the Field Strength. K. F. Niessen. *Physica,* 1. *pp.* 783–796, *July,* 1934. *In German.*—Mathematical. It is shown that $M°/M$ is not equal to $-\frac{1}{3}$ but to $-\frac{1}{3}(1 + 3\,\mu_n{}^2H^2/20\,W_o{}^2)$, where $\mu_n = eh/4\pi mC$ and $W_o = (3n/8\pi)^{2/3}\,h^2/2m$. W. R. A.

4347. Groups of Electromagnetic Waves in Anisotropic Media. G. Peretti. *Accad. Lincei, Atti,* 19. *pp.* 624–628, *May* 6, 1934.—Discusses the properties of groups of electromagnetic waves, depending on the frequency and emanating from the same epicentre, in a medium which is magnetically isotropic but electrically anisotropic. It is shown that in addition to waves of the first order there exist also waves of the second and third orders [see Abstract 2780 (1933)] in such a medium, and their chief kinematical properties are investigated. A. J. McC.

4348. Current and Constant Magnetic Field. L. Lombardi and E. Bottani. *Accad. Lincei, Atti,* 19. *pp.* 759–762, *June* 1, 1934.—The question having arisen as to whether a continuous current in a homogeneous conductor can alter under the influence of a constant magnetic field, the authors report decidedly in the negative. A. D.

4349. Theory of Maxwell's Equations and the Calculus of Matrix Operators. R. Kwal. *J. de Physique et le Radium,* 5. *pp.* 445–448, *Aug.,* 1934.—The application of quaternions to Maxwell's theory is briefly discussed and it is shown how two quaternionic representations employing real matrices of 4 lines and 4 columns can be used to derive the value of the Lorentz force and the electromagnetic energy tensor. J. S. G. T.

4350. Mechanical and Magnetic Anisotropy in Polycrystalline Ferromagnetic Discs in Magnetic Fields. A. Drigo. *N. Cimento,* 11. *pp.* 345–356, *June,* 1934.—Following the work of Akulov and Brüchatov [see Abstract 1207 (1933)], it has been observed that in a disc of magnetic material, there are places of stability and instability as it is rotated in a uniform magnetic field. Measurements are made by means of amplification of the electric current produced and observed by a sensitive galvanometer. Results show that in a polycrystalline substance (1) the material has a magnetic structure with prevalent orientation in one or two directions, and (2) stability is only obtained by having the magnetising field sufficiently great to turn all the magnetic elements parallel to itself, thus overcoming the couples due to the natural bearing of the elements. [See Abstract 4668 (1933).] H. M. B.

4351. Coil Arrangements for Producing a Uniform Magnetic Field. F. K. Harris. *Bureau of Standards, J. of Research,* 13. *pp.* 391–410, *Sept.,* 1934.—A simple method is described for constructing coils which will give a magnetic field that is nearly uniform in magnitude and direction throughout a long cylindrical volume. A study is made of three types of coils and in each case formulæ permitting the computation of the field are developed. Data are given showing the departure of the field from uniformity in specific cases and a procedure is outlined for the design of such coils. AUTHOR.

See also Abstracts **4095, 4342.**

MEDICAL RADIOLOGY AND ELECTROLOGY.

4352. Standard Ionisation Chamber for Grenz Rays. L. S. Taylor and C. F. Stoneburner. *Radiology,* 23. *pp.* 22–30, *July,* 1934.—A special ionisation chamber is described in detail, to measure very soft X-rays (Grenz rays) produced at 3 to 12 kV and to allow the intensity to be expressed in terms of roentgens per min. By use of a very small guarded-field ionisation chamber (5 × 5 cm.) the necessary absorption correction is much reduced, and errors are so minimised. It is shown that the air absorption corrections must be determined separately for each beam of radiation and the chamber is so designed that these corrections may be determined without the use of other special apparatus. The method of making these measurements is described in detail. Compared to X-rays produced at higher voltages between 40 and 90 kV, the variations produced with the ionisation chamber described, calibrated by a standard ionisation chamber, is $\pm 0{\cdot}5\,\%$, but, to attain this accuracy, special precautions have to be taken in the construction and measurement of the limiting diaphragm and copper electrode. B. J. L.

4353. Gas X-Ray Tube for Irradiation with Soft X-Rays. H. Kersten. *Radiology,* 23. *pp.* 60–63, *July,* 1934.—Gives very full constructional details, with diagrams, of an X-ray tube intended for use with soft rays of wave-length longer than 1·Å, for biological experiments. The tube employs a kathode and is operated, during use, in direct connection with evacuating pumps. X-rays are emitted *via* a cellophane window, two types of window being described. Arrangements are present to permit alteration of the size of the focal spot upon the target, and the grounded end of the tube is water-cooled. Excitation is by means of a two-valve generator, giving full-wave rectified, pulsating current. B. J. L.

4354. Thickness of Aluminium to be Used in Addition to Copper Filters. A. Mutscheller. *Am. J. of Roentgenology and Radium Therapy,* 32. *pp.* 92–93, *July,* 1934.—In therapeutic X-ray work it is the custom to insert an aluminium filter to absorb the secondary radiation from a previous copper filter. It has also become the practice to increase the thickness of the aluminium filter, but the author points out, that unlike heavier metals, aluminium only generally absorbs penetrating radiation, so that there is no beneficial filtration effect and the thickness of aluminium used, should only be sufficient to absorb the heavy-metal filter secondary radiation. Tests are described in which ionisation measurements were made after filtration *via* copper plus various thicknesses of aluminium. It is shown that a thickness of 0·25 mm., or at the most 0·5 mm. Al is sufficient to absorb all the secondary radiation of the copper and above these values there is no further useful result, but, on the contrary, only a general absorption and weakening of intensity. B. J. L.

4355. Photobiological Action of X-Rays. H. Schreiber. *Naturwiss.* 22. *pp.* 536–540, *Aug.* 10, 1934.—From consideration of the mortality and variability curves for cells under the action of X-rays as given by Glocker, the author concludes that the effects may well be due to the action of the radiation in a physical sense, as distinct from biological variations. This argument is supported by the observation of Holthusen that the shapes of the curves are practically independent of the wave-length of the X-rays used. A mathematical expression for the shape of the mortality curve is worked out, and the physico-biological significance of the various terms is discussed. G. E. B.

4356. Exponential Law of Tissue Recovery Applied to Radium and Radon Dosage. M. M. D. Williams. *Radiology*, 23. *pp*. 64–70, *July*, 1934.—It has often been assumed that tissue recovery from radiation follows an exponential law. Such recovery is calculated from the time between treatments. The law may hold for treatments given over a very short interval, during which there is negligible tissue recovery, but does not hold when the treatment, as with radium and radon, lasts over a considerable period and recovery is occurring during actual treatment. The author presents mathematical equations to cover treatments where radium and radon are applied over periods, and data are presented applicable to applicators of unit strength, by use of a recovery constant, assumed correct for filtration *via* 0·5 mm. of gold or platinum. A technique for radium and radon treatments, corresponding to the saturation technique of X-ray therapy, is proposed. Methods are given to compute the necessary time of application of radium and radon of different strengths, to produce the same tissue reactions. The results obtained suggest it may be important to apply an amount of radiation, which will produce a definite saturation dose, at a definite time after the commencement of irradiation. B. J. L.

4357. Radioactivity of Radium Bromide Solutions for Internal Medication. W. E. Boyd. *Brit. J. of Radiology*, 7. *pp*. 471–475, *Aug.*, 1934.—Describes a photographic method of examining the γ-ray activity of radium bromide solutions of dilutions from 1 in 100,000 to 1 in 1,000,000. The apparatus comprises a Rajewsky-Geiger counter and amplifier, shielded from ultra-violet light and connected to an electrometer which recorded the kicks on a moving photographic paper. A suitable electrometer was found in the Einthoven string galvanometer used in conjunction with an output transformer with resistance control. A copper fibre and magnifying optical system were used so as to produce a broad band on the photographic paper, and the kicks registered as discontinuities. Some clinical observations are given. G. E. B.

4358. Phase-Shifting Transformer. F. H. Gage. *Journ. Sci. Instruments*, 11. *pp*. 289–295, *Sept.*, 1934.—A design is given for a phase-shifting transformer suitable for use at audio frequencies. The associated apparatus used with two of these instruments is described. Kathode-ray oscillograms showing a set of straight lines illustrating amplitude constancy with phase shift are included. A method is described for the calibration of the phase-shifting transformers using the kathode-ray oscillograph but without the use of measurement of phase angle from the shape of an ellipse. Calibration curves for frequencies of 800 and 4000 are given and discussed. AUTHOR.

See also Abstracts **4171, 4219.**

OSCILLATIONS.

4359. Heterodyne Beat Apparatus. J. D. Stranathan. *Rev. Sci. Instruments,* 5. *pp.* 334–336, *Sept.,* 1934.—In the heterodyne beat method of measuring dielectric constants of vapours or very dilute liquid solutions, it is difficult to eliminate frequency drift in the one oscillator. Apparatus which will almost completely eliminate this drift is described; it has the further advantage of operating entirely on a.c., this eliminating much inconvenience and appreciable battery upkeep. The apparatus is portable, and therefore useful as a laboratory piece as well as for research. AUTHOR.

4360. Self-Oscillations in Systems with Continuous Distribution. A. Witt. *Phys. Zeits. d. Sowjetunion,* 5. 6. *pp.* 771–795, 1934. *In German.*—A theoretical discussion is given of the self-oscillations in a Lecher-wire system, the case where the oscillations are nearly sinusoidal only being considered. The excitation conditions are given, the amplitudes of the stationary oscillations calculated and their stability investigated. As an example, the oscillations in a Lecher-wire system are considered, one end of the system terminating at a condenser, the other end being connected to a negative resistance device with falling characteristic. In general such a system gives rise to a number of harmonics. Increasing the resistance renders the lower harmonics unstable and the system, if started on one of the lower harmonics, jumps to higher harmonics with smaller amplitudes. If the resistance is cut out the oscillations do not die out, but persist with greater amplitudes and in this way the system can pass from one type of oscillation to another. A. W.

See also Abstracts **4219, 4294, 4323.**

PHOTOELECTRICITY.

4361. Theory of the Surface Photoelectric Effect in Metals. Part I. K. Mitchell. *Roy. Soc., Proc.* 146. *pp.* 442–464, *Sept.* 1, 1934.—The theoretical position of the surface photoelectric effect in metals is discussed, and objections are raised against the theories of Wentzel and Fröhlich. The photoelectric emission due to a single surface is calculated by two methods, and the results obtained are in agreement. Tamm and Schubin, using the same assumptions, obtained a different result, which is shown to be incorrect. The results of a more general calculation of the effect due to a single surface, taking into account the effect of reflection and refraction of the light wave, are quoted, and the theoretical spectral distribution curves given for potassium, and compared with experiment. AUTHOR.

4362. Photoelectric Emission from Adsorbed Films. R. Suhrmann. *Ergeb. d. exakt. Naturwiss.* 13. *pp.* 148–222, 1934.—This paper gives an account of present knowledge of this subject. An outline of the theory of photoelectric emission is given, followed by an account of the physical and chemical properties of adsorbed films. The photoelectric properties of simple adsorbed gaseous and metallic films are dealt with fully and then follows the treatment of compound films, such as the Cs-Ag-O films used in modern commercial cells. Temperature effects are described. In conclusion, there is a section on the effect of field strength on the emission. A lengthy Bibliography is appended. D. H. F.

4363. Differential Circuit for Blocking-Layer Photoelectric Cells. L. A. Wood. *Rev. Sci. Instruments*, 5. *pp.* 295–299, *Aug.*, 1934.—The use of a differential photoelectric cell circuit employing two cells of the blocking-layer dry disc type is of advantage where a difference between two light intensities is to be measured or to serve as control, especially where fluctuations of the source prove troublesome, or where the difference to be measured is small. Experimental as well as theoretical consideration of the circuit in which terminals of opposite polarity from the two cells are connected together, with a meter or relay in parallel with the cells, shows many desirable features in respect to sensitivity, linearity of response, and stability. The advantage arises fundamentally from the fact that the effective resistance across each cell under these conditions is very low. The circuit is useful either as a null method or for obtaining, on a current-measuring instrument, scale readings proportional to light-intensity difference. Linearity is obtained over approximately the same range as for a single cell, the rate of change with light intensity being approximately the same. A comparison with the arrangement hitherto chiefly employed, which balances open-circuit voltages, indicates advantage in all respects of the circuit here described, which should consequently prove of wide utility. AUTHOR.

See also Abstracts 4138, 4292, 4293, 4300, 4308.

PIEZOELECTRICITY.

4364. Recording Instrument for Transient Pressures. H. W. Baxter. *Electrician*, 113. *pp.* 121–122, *July* 27, 1934.—A description is given of apparatus designed for the piezoelectric recording of transient pressures. The essential features of the system are as follows: The pressure to be recorded is applied by means of a diaphragm to a face of one of two crystals mounted in a brass container with an insulated electrode between them. The voltage developed on the crystals by the pressure is amplified by a 3-stage battery-coupled amplifier, the output from which operates a Duddell oscillograph recording on the same drum as the voltage and current oscillographs connected to the apparatus under test. Owing to leakage the apparatus could not be calibrated by the application of static pressures and a method of calibration was employed in which the charges due to static pressures were allowed to leak away, when sudden release of the pressure developed charges of the opposite sense. For this purpose the connections from the crystal holder to the amplifier were reversed. Difficulties experienced in the practical operation of the apparatus are described and its advantages and disadvantages are briefly discussed. A. W.

THERMIONICS.

4365. Diffusion of Positive Ions of Salts through Copper, Silver and Gold at High Temperatures. J. Cichocki. *Ann. de Physique*, 2. *p.* 160, *July–Aug.*, 1934.—A correction. [See Abstract 1759 (1934).]

See also Abstracts 3966, 4294.